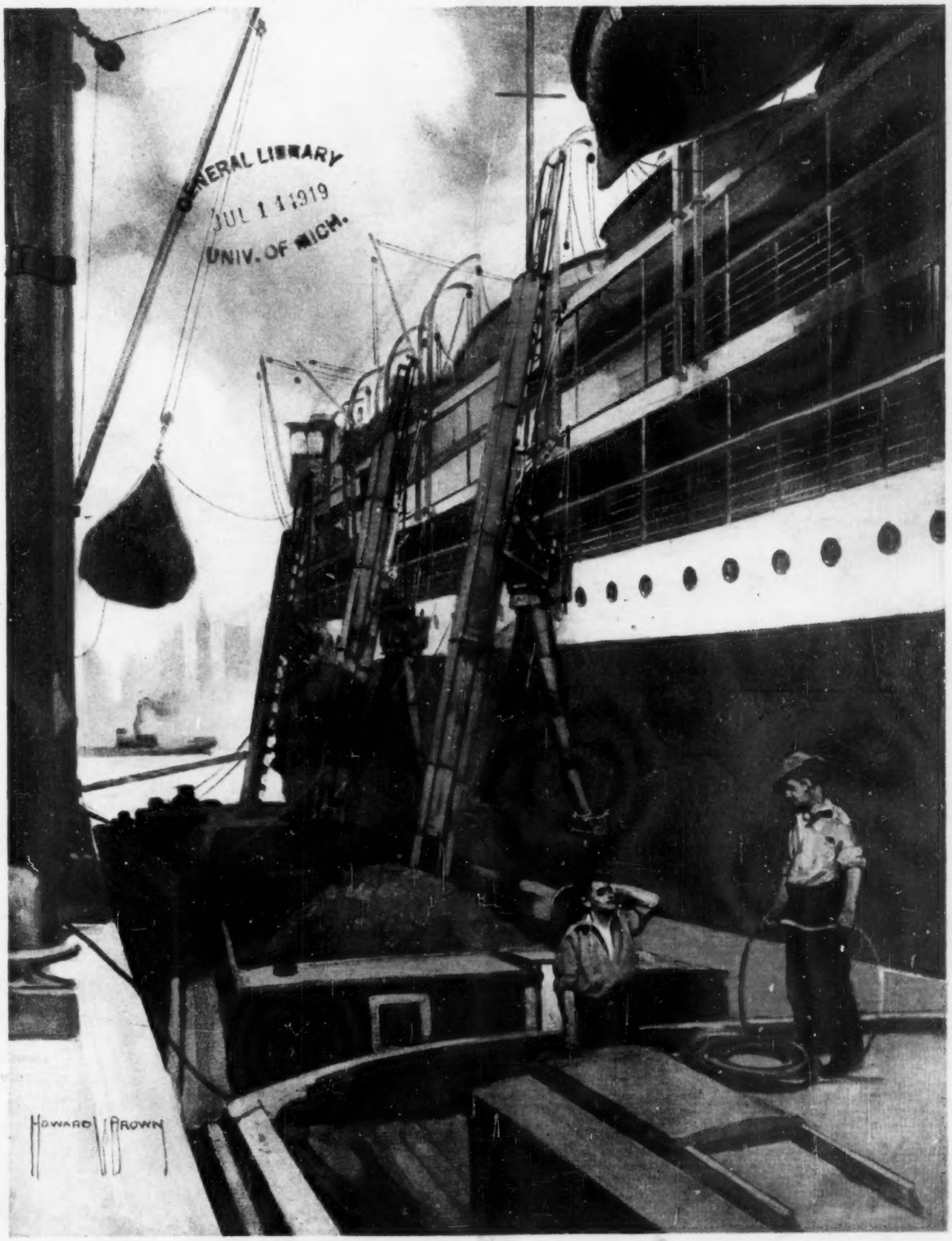
When you finish reading a magazine bearing this notice, place a 1-cent stamp on this notice, mail the magazine, and it will be placed in the hands of our soldiers, sailors or marines. NO WRAPPING. NO ADDRESS.
A. S. Burleson, Postmaster General.

SCIENTIFIC AMERICAN

Entered as second class matter June 18, 1879, at the post office at New York, N. Y., under the Act of March 3, 1879.



COALING BIG SHIPS BY MEANS OF ELEVATOR-CONVEYORS—[See page 36]

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July 12, 1919

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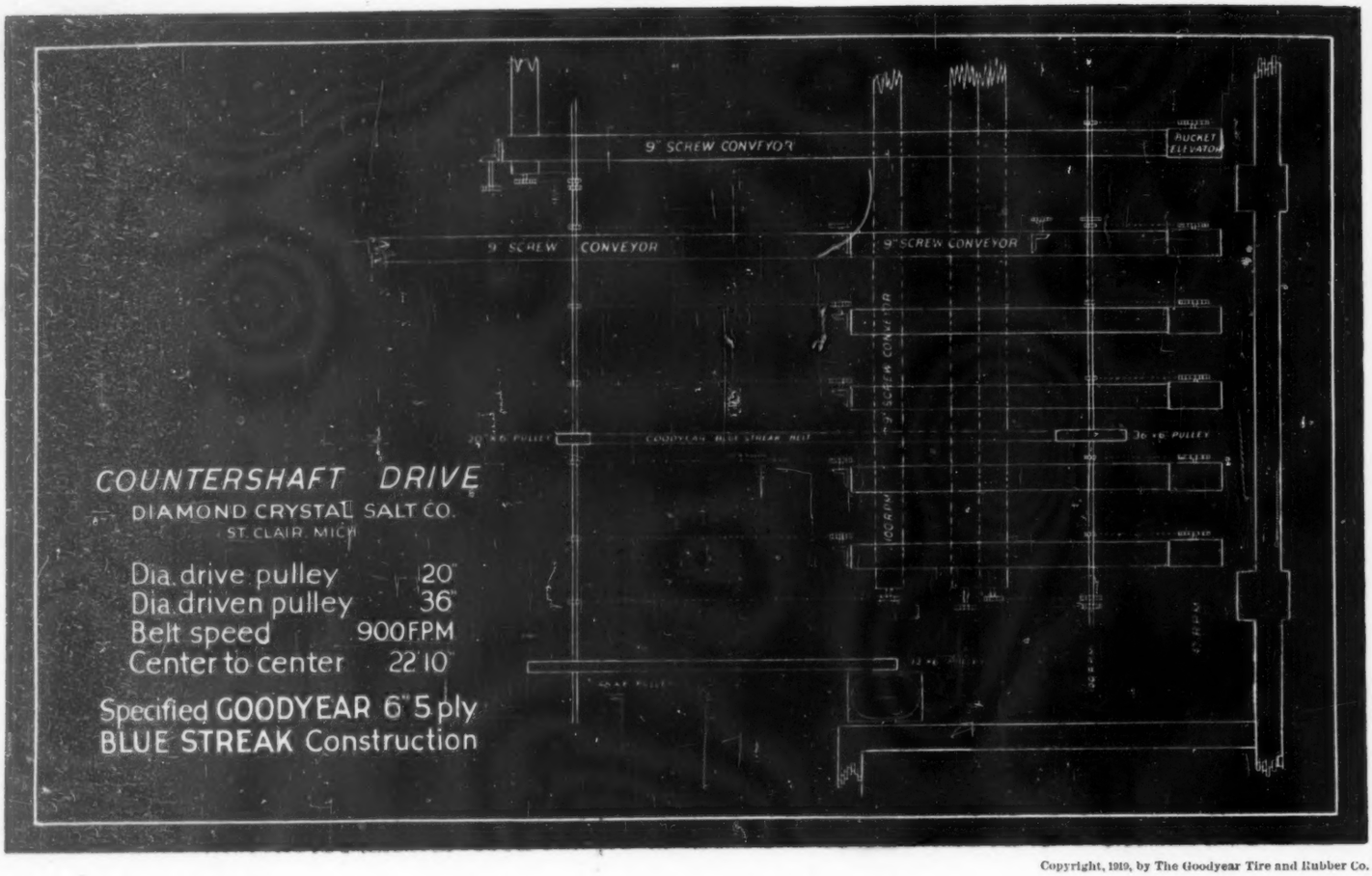

Copyright, 1919, by The Goodyear Tire and Rubber Co.

Saving $444.38 on a Countershaft Drive—and the G.T.M.

The Diamond Crystal Salt Company of St. Clair, Mich., had been having a lot of trouble—and paying many high belting bills—because of a motor drive to a countershaft operating five elevators. The expensive standardized belt they had been using cost in 1917, $1.60 a foot—$84.80 for the 53 feet required. It generally lasted about three months, and required many take-ups at that.

One day a G. T. M.—Goodyear Technical Man—called and explained the Goodyear Plan of selling belts to meet conditions instead of as a hardware man sells nails. The Purchasing Agent, Mr. Engelgau, was interested, told him about the countershaft drive that cost $28.26 a month, and asked him to look it over.

The G. T. M.—our Mr. J. G. Taylor—studied that drive, studied all the conditions carefully and in detail. After making his measurements he told the P. A. he recommended for that drive a certain type of Goodyear Belt costing then 68c per foot—$36.04 for the belt. The P. A. thought he couldn't lose anything at that price—even if the belt ran only five weeks—and told him to send it along.

On Dec. 1, 1917, that belt was installed. At the time this advertisement goes to press the belt is still running and in good condition. It has already given 17 months' service for the $36.04 spent for it. That seventeen month's service for the standardized $1.60 belt would have cost at the prices of the time at least $480.42. The G. T. Ms. service in specifying the right belt for the service represents a saving of $480.42 minus $36.04, or $444.38.

The belt has also reduced slippage and take-ups to a minimum never before attained on that countershaft drive. Not only does it save money, but it saves trouble and prevents interruptions formerly customary.

If you have a belt-devouring drive that is eating too many dollars, ask a G. T. M. to call. He'll do it without charge when next he is in your vicinity. There are many of them—all trained in the Goodyear Technical School—all with experience in plants similar to yours—all selling belts to meet conditions and not as a grocer sells sugar. The G. T. M.'s services are free simply because the savings they effect for purchasers are so considerable that a gratifying volume of business from the plants served is certain to come to us within a few years.

THE GOODYEAR TIRE & RUBBER COMPANY, AKRON, OHIO

BELTING · PACKING · HOSE · VALVES

GOODYEAR

AKRON

How Factory Lighting Influences Home Life

CORRECT industrial lighting benefits more than the factory installing it. Authorities state that lighting conditions of a factory have a very definite influence on living conditions of the workmen. Too bright a light—too dim a light—too many changes in the intensity of the light all have a direct effect on the workman and his work.

The pupil of the eye is more sensitive, more active than most people realize. It is constantly changing in size with different intensities of light. And every change affects its efficiency and soon has a telling effect on the physical condition of the workman.

A well known Massachusetts authority recently stated: "Fatigue comes more quickly from eye strain than from any amount of muscular work."

Benjamin Industrial Lighting
Helps to Make Happier, Healthier Workmen

This scientifically correct method of factory illumination reduces the physical and mental fatigue that results from eye strain. It keeps workmen in better spirits. It makes them better husbands and better fathers as well as better workmen.

You can help your community as well as your business by installing Benjamin Industrial Lighting. Interesting booklet upon request of an executive.

Address request for booklet to Advertising Department, Chicago

BENJAMIN ELECTRIC MFG. CO.

Sales Offices

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243-247 W. 17th St. NEW YORK
590 Howard St. SAN FRANCISCO

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Two-Way Plugs
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Benjamin Industrial Lighting
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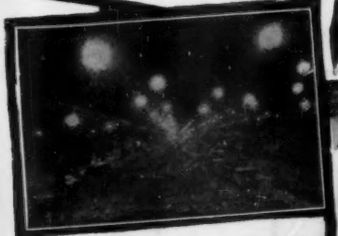
Automobile Specialties
Panel Boards and Cabinets
Punch Press Efficiency and Safety Devices
Porcelain Enameled Reflectors and Specialties
Castings in Aluminum, Brass and Alloys
Drawing Stampings and Spinnings in Sheet Metal
Consulting and Engineering Service

Benjamin Dome Reflector Socket—Reflector and Lamp Manufacturers' standard. An industrial lighting unit for use in general factory illumination as well as outdoors.

Benjamin Elliptical Angle Reflector—for use in lighting areas from the side, such as erecting shops where cranes or other machinery occupy center of space. For loading platforms, etc.

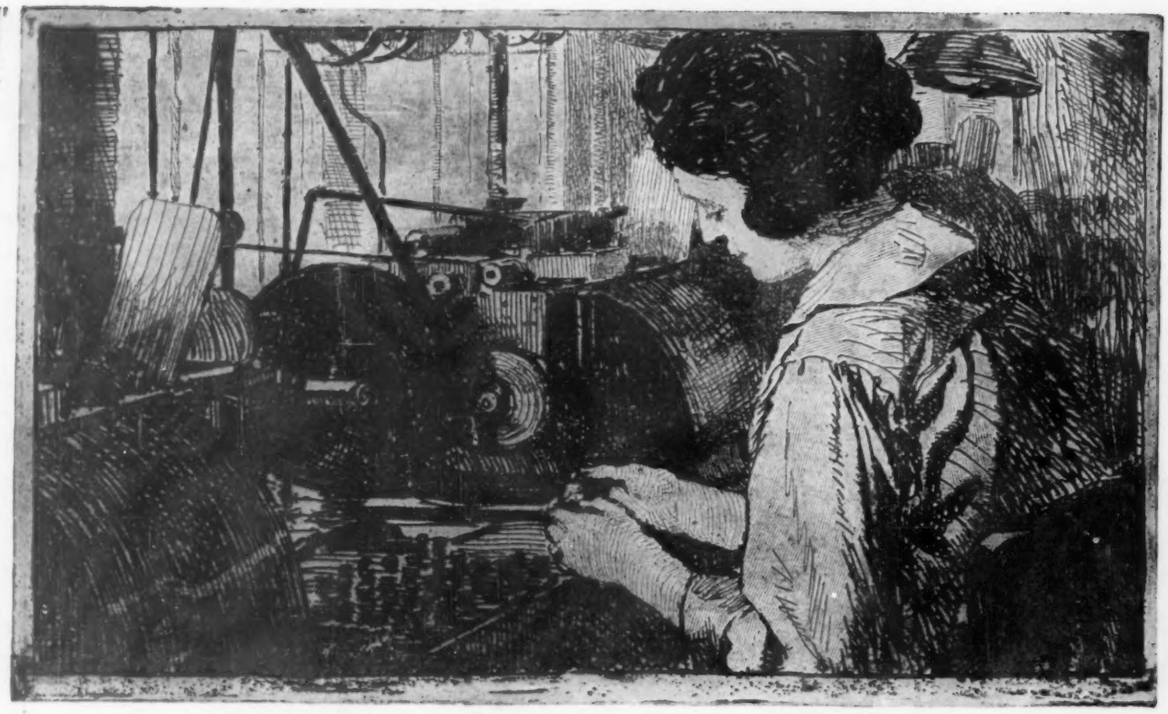


Benjamin Deep Bowl Fixture for use in big shops with large Mazda "C" Lamps. Despite high mounting there is adequate light on this foundry floor.

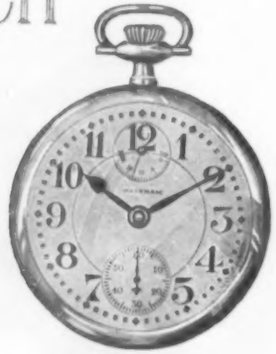
BENJAMIN

Makers of Things More Useful

WALTHAM THE SCIENTIFICALLY BUILT WATCH



AND THE FOREIGN BUILT WATCH



The Vanguard
The World's Finest Railroad Watch
23 and 19 jewels
$60 and up

Facts You Should Know Before Selecting a Watch

BETWEEN the two supporting plates of a Waltham watch, which together constitute a frame, is mounted a system of gearing, called a Time Train. The reader has learned that the motive power of the watch is derived from the mainspring. At one extremity of the train is a hardened and tempered steel barrel (another Waltham creation) which contains the mainspring. When the thumb and finger wind the mainspring, its stored energy is delivered to the next wheel in the train and from that to the next, and so on.

This train consists of four wheels and pinions. The center wheel is in the exact center of the watch, and directly connected through the cannon pinion (so called because it is shaped like a cannon) with the wheels that control the hour and minute hands; and through this center wheel the power of the mainspring is carried onward through the other wheels of the train to the escape wheel pinion, which we will illustrate in its proper place.

The train of a Waltham watch — each wheel, each pinion — is cut to the fraction of a human hair — mechanically perfect, interchangeable for the serial watches they are made for — standardized in perfection, in absolute exactness and quality, made by machines tuned to infinitesimal gauge-fit and untouched by human hands.

The "train" of the imported watch is made by the old hand process. It is not interchangeable, and it is of varying quality.

This vital part of the Waltham watch is another of those reasons why the horologists of great nations came to Waltham for time, and why your watch selection should be a Waltham.

Waltham placed America First in watchmaking.

This story is continued in a beautiful booklet in which you will find a liberal watch education. Sent free upon request

WALTHAM

THE WORLD'S WATCH OVER TIME

SEVENTY-FIFTH YEAR

SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

VOLUME CXXI.
NUMBER 2

NEW YORK, JULY 12, 1919

10 CENTS A COPY
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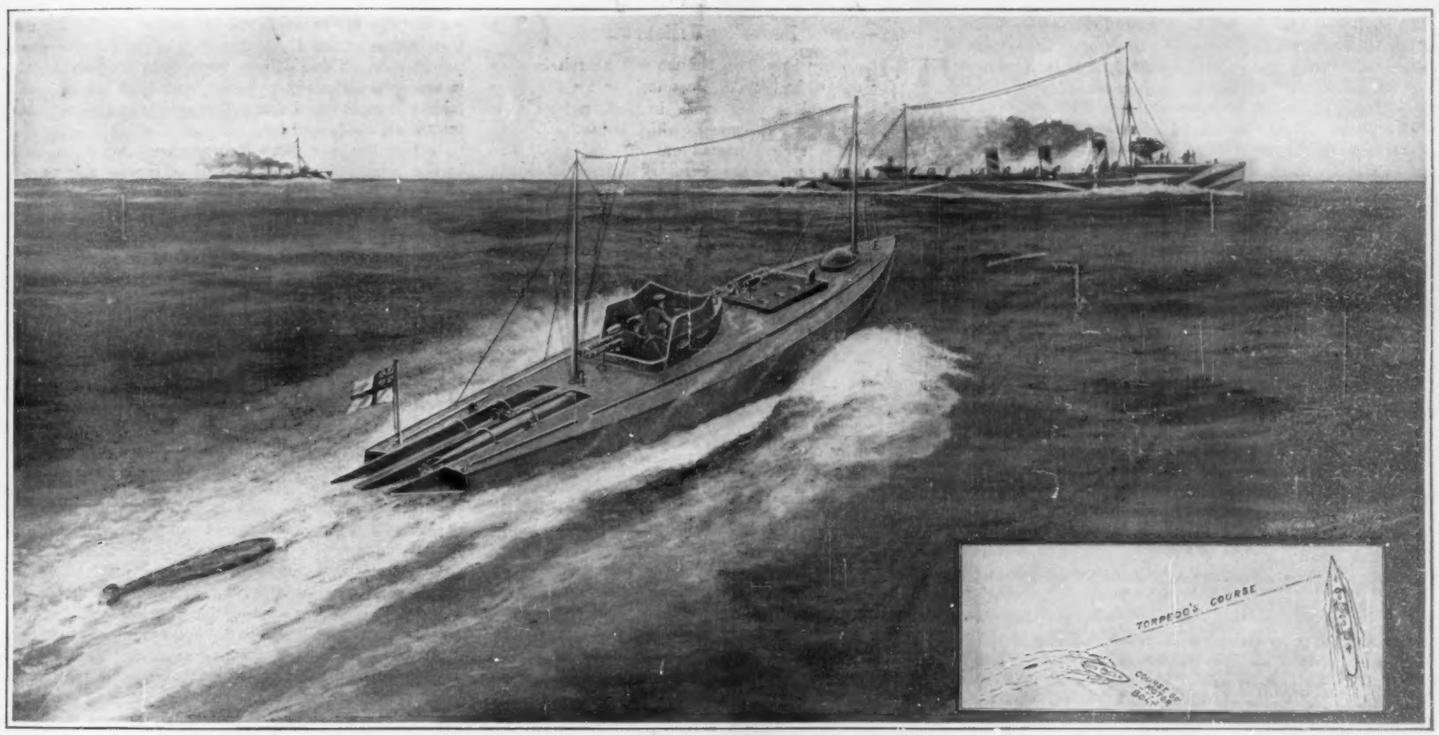


Length of boat 55 ft.; beam, 11 ft.; draft 3 ft. Armament, two 18-in. torpedoes; four machine guns. Speed, 40 knots. Torpedoes are launched, tail first, over the stern, the boat turning aside to let them pass.

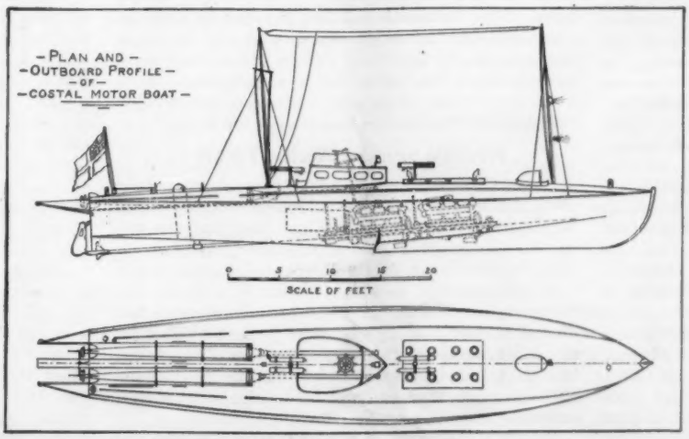
One of the Coastal Motor Boats Making a Torpedo Attack

The Revival of the Torpedo Boat

ONE of the most novel and successful types of fighting craft developed for service in the Channel and the North Sea was a small high-speed vessel to which the British gave the name of Coastal Motor Boat. These little vessels were in a sense a revival of the original torpedo boat, which was abandoned many years ago by all the navies of the world. The similarity lies in the high speed and small size both of the original and its modern revival; but whereas the torpedo boat possessed a round hull of the type prevalent in those days and was driven by steam engines at a speed of from 18 to 22 knots, the modern coastal motor boat is nothing more nor less than a racing motor boat of a modified hydroplane type, equipped with internal combustion engines and driven at speeds of from 35 to 40 knots.

The principal motive for building these boats was to enable a torpedo attack to be carried on in shoal, coastal waters. Large torpedo carriers such as destroyers and submarines are limited in their inshore operations by their comparatively heavy draft of eight to ten feet, which confines them to fairly deep water and exposes them to danger from mines. Early in the war, there was a call for the development of a fleet of small, high-speed craft, drawing only a foot or two of water and capable of carrying and launching the torpedo, and the Thornycroft firm who built the first 60-foot torpedo craft in 1878, designed a high-speed motor boat with a special form of hydroplane hull, and equipped with a torpedo carried in a dropping gear such as is still used in naval boats. With the collaboration of Lieutenants Hampden, Brenner and Anson, of the Harwich force, designs were prepared for a 30-knot boat of the racing motor boat general type, capable of carrying a torpedo and the necessary discharge gear for the torpedo, with tanks for extra fuel.

At the outset it was necessary to dismiss the proposed dropping gear, first because it was unsuitable for torpedoes larger than 14-inch, and secondly because it necessitated the slowing down of the boat before the torpedo could be launched. The three officers above mentioned, who volunteered to take charge of the boats, insisted that as the sole object of the new craft was to attack, arrangements should be made to discharge the torpedo as the boat advanced at high speed. Launching from a trough at the bow by means of a ram impulse gear, as was done in the early torpedo boats, did not conduce to safe and accurate practice, and launching from the stern would have necessitated turning for the attack to be made. Eventually it was determined to discharge the torpedo over the stern, tail first. The boat was built with this idea incorporated. The accompanying drawings are based upon illustrations which appeared in *The Engineer*, London, of June 6, 1919; and reference may be made to that issue for fuller details than are here given.



These 40-knot boats did not hesitate to attack enemy destroyers. They performed good work at Zeebrugge and Ostend

Since a naval weapon loses much of its value if the enemy is forewarned the boats were built on an island in the Thames and every precaution was made to secure secrecy. The first three boats, finished in April, 1916, were tried out, mostly in the night time, at Queensborough, and after a period of training four boats were sent to Dunkirk where contact with the enemy was soon established. The coastal motor boat at once justified its existence by torpedoing a large German destroyer. On several occasions in this attack the boats came under

(Continued on page 44)

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

The City Hall and Its Setting

ART, sentiment and tradition have given to City Hall Park and the exquisite building which is its central adornment a secure place in the regard of the American people. If New York is our best-known and most widely-visited city, surely this little triangular plot, with its dainty and time-honored building, is the city's best-known and most honored civic and historic center. New York is none too rich in structures that possess high architectural merit, and its list of historic buildings, all too scanty, is shrinking daily under the sinister labors of the real estate agent and the house-wrecker.

Conspicuous among our city buildings that possess historic interest and first among them in its architectural charm and beauty is the City Hall, a marble structure built over a century ago in the style of the French Renaissance.

It is a small building, as city halls go; but so perfect are the proportions, both in the massing of the building as a whole, and in its decorative details, that this gem of the early years of the nineteenth century reposes with satisfying municipal dignity, amid the Brobdingnagian twentieth century structures that hold the little park, as it were, in their lap.

When the City Hall was completed and for many a decade after that, the building had the park entirely to itself—which was entirely as it should be. For the triangle lying between Chambers and Vesey Streets is none too large a setting. In those early days many noble trees, of which only the remnants are still with us, adorned the park, and it was dignified by a lofty iron railing with which it was entirely enclosed. Our forefathers could stand on Broadway, opposite St. Paul's Church, and have an unobstructed view of the whole park, with the undiscolored marble walls of the City Hall showing in pleasant contrast to the green sward and foliage with which it was set about.

Unfortunately the decadence in art and architecture which succeeded the stately Georgian, Colonial and Renaissance period laid its hand heavily upon New York, and nowhere in New York so cruelly as upon our little downtown park. A gaunt horror in brick, the Hall of Records, was built to the east of the City Hall; Tweed's very commonplace Court House, of evil associations, crowded closely in its rear; and finally, as if to add insult to injury, the Federal Government raised upon the southern apex of the park that elephantine architectural monstrosity which houses the General Post Office and the Federal Court.

Everyone having a voice in the matter should support the resolutions adopted, recently, at a conference of government and city officials in New York, by which it is proposed to remove the Post Office building and erect a new Federal building on the large tract of land, near the park, which was purchased for a new court house. There is adequate space, locally, for the three buildings, federal and municipal, which now disfigure the City Hall Park.

With the Post Office and other encumbrances removed, there would remain only the City Hall and the old fountain that faces its main entrance. The fountain is another legacy of the period of architectural and artistic decadence which gave us the nearby Post Office; but fortunately the sculptor MacMonnies is engaged, or is supposed to be, on a new fountain, which, if it proves to be up to the level of his previous work, will be a decided artistic adornment. But when the park is rid of its present disfigurements, it should be placed in the hands of our foremost architects and landscape gardeners for treatment. An early print shows it to have been enclosed by tall railings with an imposing carriage entrance opposite Vesey Street. Would it not add distinction to enclose once more the park with a railing, broken at intervals with entrances of appropriate design matching the architecture of the City Hall?

Books for Bullets

THE future tourist in France will search in vain for the University of Beaune; for by the time that travel is once more in full swing it is probable that the wooden shacks which house its faculty and students will have passed out of existence. The University of Beaune, as the Secretary of War called it in a recent address at New York, was built in response to the request of the men of our Army for education during the months succeeding the end of the war. The Armistice, coming like a bolt out of the blue, brought the problem of how to employ two million young American soldiers until they could be returned to the United States. The answer on the part of some of the Commanding Generals was to drill the men until they were so tired that they couldn't think of anything else; but "finally the boys themselves gave the answer; they said 'we don't want to drill. The war is over. We want education. Can't there be some sort of provision made here, by which those who know can teach those who know less?' "

The Army itself answered the question, and Mr. Baker at his last visit found at Beaune, the American Expeditionary Force University, consisting of 11,000 students. In that university were eleven full-fledged colleges—divinity, law, medicine, dentistry, agriculture, veterinary surgery, drawing, painting, music and science pure and applied. The students were taught sometimes by educational experts sent from America, sometimes by army officers, and very often by enlisted men. Says the Secretary: "I had the very great delight of going into room after room in that university, which, by the way, was composed entirely of shacks. There would be a blackboard and a little platform, but none of the paraphernalia of a great university." The Secretary speaks of finding in one room a private on the platform, teaching integral calculus to a class of fifteen or twenty men, of whom two or three were majors, some captains, some lieutenants and others corporals, sergeants and doughboys. Well may he say that we had here an instant reversion from the artificial hierarchy of rank into the natural hierarchy of superiority of intelligence and intellect.

But the University was "only the core of the apple." Men selected and sent from every Division to one of the colleges, returned after a brief course and assembled the men who were still needed in France, but still wanted instruction, and taught them; and this normal school spread its influence throughout the whole Expeditionary Force. The University had the audacity to open up a correspondence school, which grew to great proportions. Moreover, France and Great Britain invited our men to take courses at their universities—an opportunity which was widely used. Well might the Secretary exclaim: "Nothing like that has ever happened in the world!"

Progress with the Electric Furnace

SOME illuminating facts as to the progress of the electric furnace were brought out at a recent joint meeting of the Iron and Steel Institute and the Institution of Electrical Engineers. Previous to 1914 we recorded in these columns the progress of this new development in the United States and in France and Germany, and when the war opened the electrical method of steel making was showing rapid progress. How far the war has affected this particular phase of the American steel industry we cannot say, but the papers given at the above meeting are a good indication of the general results obtained in Great Britain.

We are surprised to learn from *Engineering* that the prevalent impression at the gathering was that electrical furnaces were troublesome and expensive and that the outlook for their competing in the open market with other methods of steel manufacture were not encouraging. We are inclined to think that the pessimism due to the severe strain of the war is responsible in some part for this discouragement; for the last reports which we have had from our own steel makers were decidedly encouraging.

The difficulties seem to have been due to mechanical difficulties largely resulting from errors of design. There has been trouble with the furnace, with the electrical gear, with refractories and with the electrodes. Often the furnaces have been built too light for the severe conditions of service. Most of these troubles arise in the electrode gearing and in the tilting mechanism, resulting in fractures of the electrodes and short circuits and in some cases in the complete breakdown of the furnace. Overloading caused trouble in the transformers and switch gear. These defects have been met by putting in ample transformer capacity and both on the electrical and mechanical side better results and more consistent work are looked for.

During the war great improvement has been made in the brick linings and British magnesite can now be obtained which is equal to the Continental brick. Overhang in the walls is fatal and the bottom must be carried well up the side walls to protect them from the slag. As to electrodes the graphite type although it gives no trouble is very costly, while the cheaper amorphous carbon electrodes have given great trouble through cracking and bad joints. Great improvement has to be made in the amorphous carbon electrodes before they can compete with graphite. The induction furnace in spite of its theoretical efficiency is practically abandoned in favor of the direct-arc type; but after all is said and done it is not so much a question of the manner of application of the heat as of the proper design of the furnace.

So much for the defects. As a matter of fact, the papers read at the meeting proved that with intelligent supervision the electric furnace can produce a large output of high quality steel of any composition. Thus, Col. D. Carnegie instanced a shop with 10 six-ton furnaces which was started for war work in Canada and produced over 400 tons per day of special steel—an excellent performance when we remember that it meant a steady rate of seven charges for 24 hours and an output of high grade alloy steels and high grade castings.

Of course the success of the electric process on a large scale is eminently tied up with its cost, the principal items of which are the cost respectively of labor, electric current, electrodes and scrap. Labor costs will naturally decrease as the size of the individual furnace increases. Thus with the addition of two laborers, a 20-ton furnace could be run by the same number of men as are necessary to run a three-ton furnace. The small furnace can already turn out high grade steel at a much lower cost than its only competitor—the crucible process—and as furnaces grow in size the labor cost should be less than that for the open hearth. As to the cost of current in Great Britain we are told that at the estimated figure of about $16 a ton the fuel cost would be six times the fuel cost of the open-hearth practice. The only hope of reducing this will be when several furnaces are running together and the variations in power can be minimized and a good load factor obtained. The minimum for this is about eight furnaces and at present in Great Britain shops with this number are very few. It is estimated that to compete with open-hearth work the cost of current would have to be brought down to four cents per unit. This consideration alone seems to shut out the electric furnace as a producer of the cheap classes of steel and limits the field to the production of special alloy steels or to the production of steel castings where sound steel is essential.

Finally, there is the question of scrap which is necessary as a charge for the electric furnace and here the British are in some trouble because of shortage. It is known that turnings and light scrap form the most suitable charge for electric furnaces and in a country where the engineering trades operate on such a large scale there should be no difficulty when trade becomes normal to supply furnaces with sufficient scrap for their requirements.

Electricity

Dry Cell Information is covered in full in a recent publication of the Bureau of Standards entitled, "Electrical Characteristics and Testing of Dry Cells." This publication, known as circular No. 79, gives a brief description of materials of construction and elementary theory of the operation of cells. The various kinds and sizes of dry cells are mentioned and the electrical characteristics of the cells and methods of testing are discussed. Indeed, this little book of 44 pages, which may be obtained for 10 cents by addressing the Superintendent of Documents, Government Printing Office, Washington, D. C., removes much of the mystery which is generally supposed to exist in the manufacture of dry cells.

Wireless Telephony in Night Flying.—The extraordinary value of wireless telephony for directional purposes in connection with aircraft has been emphasized recently in its relation to night flying. It often happens of course, that in daylight inter-communication between planes, or between wireless stations and aircraft, is unnecessary, but in flying across country at night the use of the wireless telephone will certainly become more and more efficacious. Some details are now available of a test carried out recently during a night flight from Kenley, England, to Paris, France, in a Handley-Page. This in no way constitutes a record, but is nevertheless interesting as indicating what is being done as a matter of routine. Wireless telephony has now been definitely adopted as means of ground to air communication and vice versa on the London-Paris route, and the test in question was made with one of the first machines on this service fitted for the purpose.

Wireless-Equipped Automobile.—When it comes to the matter of equipment, it is probable that Glenn Martin's new car is going to be the most completely equipped automobile that ever turned a wheel, states the *Wireless Age*. Glenn Martin, it will no doubt be recalled, is a leading designer and manufacturer of American airplanes, particularly the Martin Bomber. "It's going to have practically everything that an airplane has on it, including a combination wireless telephone and telegraph outfit," Mr. Martin says. "My work is divided between the flying fields and the factory, so that it is of extreme importance to me to be in touch with both places at all times, and it will be a marked convenience as well to be in communication with the aviators in their testing work in the air. At present, these wireless outfits cost $2,200, but I can foresee the time when they will not cost more than $500, and will be installed as optional equipment on many high-grade cars. They have a telephonic range of 30 miles, and the simple turning of a switch converts them into a wireless telegraph outfit with a range of 300 miles. A red light will flash on the dash of my car when someone wants to get in communication with me, and it will only be necessary to put the receiver to my ear to get the message, if I am within 30 miles of the man who wants to talk to me."

Germany's Substitutes in the Electrical Industry.—Interesting information on the use of various substitute products in the German electrical industry is afforded by the examination of pieces of apparatus captured on the battlefield. Thus a wireless interceptor, made by the Telefunken Company, was found to contain practically none of the customary materials; there was, for example, a complete absence of hard rubber, soft rubber, and brass. A piece of three-ply white wood, blacked over, was substituted for a hard rubber slab, and the coupling coils were mounted, not on hard rubber, but on papier maché with wooden ends, windings being insulated exclusively with silk and no rubber. The buzzer was mounted on stoneware, and the connecting leads were paper-insulated. In other cases (*e. g.*, accumulators, signalling apparatus, etc.), customary materials are also lacking, but it would be difficult to say in all instances whether this was due to scarcity or the deliberate use of new ingredients considered an improvement. Field telegraph wires, cables, etc. also reveal unusual constituents, continues *The Electrician*. In one case the conductor consisted of 60 per cent steel wires in a lead-sheathed cable; steel and galvanized iron wire were common, and there was evidence of a general attempt to economize in copper and rubber. While many of these were doubtless temporary expedients necessitated by the war, it seems possible that a detailed examination of such articles might furnish some useful hints for future practice.

Science

A Great Collection of Grasses.—The U. S. Bureau of Plant Industry has been gathering material since 1905 toward a "Manual of North American Grasses." The Bureau now has at its disposal a herbarium containing 130,000 specimens of grasses, the largest grass collection in the world. Keys to species have been prepared for all the genera in the United States, monographs on many groups have been published, and the material on hand is now nearly sufficient for the preparation of the remaining text of the proposed manual. This work is under the direction of A. S. Hitchcock.

Exonerating the Sea Lion.—At the instigation of Canadian fishermen, a bounty of $2 a head was placed some time ago on sea lions, on the ground that these animals were inimical to the salmon fisheries. The habits of the sea lion have recently been investigated by a commission appointed by the Biological Survey of Canada. Although the commission did not clearly ascertain just what constitutes the main food of the sea lion, it was proved that the destructiveness of the animals was too slight to warrant general slaughter. Sea lions offer possibilities of commercial exploitation in the matter of guano, leather and oil, and therefore deserve to be protected. They are very timid and can easily be frightened away from the fishermen's nets.

Meteorology in American Colleges.—Meteorology has always been a conspicuously neglected subject in the curricula of American colleges and universities. Apparently this defect is now being rapidly remedied, in consequence of the steady increase in the number of practical applications of this science in the shape of agricultural meteorology, military meteorology, aeronautical meteorology, etc. At the instance of the Weather Bureau, the Bureau of Education recently sent a questionnaire to 650 institutions of higher education in the United States concerning the amount of instruction in meteorology and climatology given therein. Of the 433 institutions that replied, 70 reported that regular courses in these subjects were given, while 83 mentioned that some instruction in meteorology was given in more general courses.

Bison Available for Museums.—At Buffalo Park, Wainright, Alberta, the Canadian Government maintains a herd of bison, which now numbers 3,561 and is the largest bison herd in existence. This herd has increased very rapidly in recent years, and, as is said to have been the case elsewhere with bison in semi-captivity, the percentage of male calves has been larger than that produced when the bison roamed wild on the plains. Thus there is a large surplus of male bison not needed for herd purposes, and these surplus animals are offered for sale to natural history museums in Canada and the United States at $250 each. Museum authorities may correspond on this subject with J. B. Harkin, Esq., Commissioner of Dominion Parks, Ottawa, Canada. Besides buying skins for mounting, it is suggested that museums may send their preparators to Buffalo Park to secure photographs, color sketches and accessories for habitat groups, and to secure skeletons, anatomical preparations of internal organs and parasites, etc.

The Dangers of Nitrobenzene.—A memoir of the Cornell Agricultural Experiment Station, by W. L. Chandler, deals with the poisonous action of nitrobenzene vapor on animals. Nitrobenzene is used in particular stages of various manufacturing processes, and because of the pleasant odor and the retarded physiological action of its vapor its toxic properties are not generally recognized; hence many workmen are seriously endangered. It is used in the manufacture of explosives (indurite); in the manufacture of anilin, which is extensively used in making dyes; in perfuming soaps, lotions, pomades and other toilet articles; as a solvent in the manufacture of shoe polish, floor wax and the like; in the manufacture of flavoring extracts and certain liqueurs; and for flavoring confections. It has also been recommended for use as a fumigant to destroy parasites on domestic animals. Mr. Chandler presents a large array of evidence to support the contention that nearly all of these uses should be prohibited by law, on account of the very dangerous and insidious character of the poisonous substance. He says that munition plants, dye works and other factories which handle nitrobenzene should be inspected with a view to installing devices to prevent workmen from inhaling the vapor or coming into contact with the liquid.

Aeronautical

Desertion by Airplane.—Desertions by airplanes across the Swiss frontier have been quite commonplace, even recently. A case in point is reported in the *Daily Express*, as follows: Two Italian aviators named Bizzolato and Stacko landed near Lugano in a powerful Caproni. They were in uniform, and declared openly that they had deserted. They carried two bicycles in their airplane. The machine was guarded by Swiss soldiers, but the occupants were liberated, as owing to the cessation of the war the authorities do not know what to do with aerial deserters. Another case is that of two Austrian officer deserters, who landed near Davos in an airplane recently.

Our New Aircraft Insignia.—The new design for all American aircraft shall soon be a red circle inside of a white, five-pointed star, inside of a blue circumscribed circle. The circumference of the inner circle shall be tangent to the lines forming a pentagon made by connecting the inner points of the star. The inner circle shall be red, that portion of the star not covered by the inner circle shall be white, and that portion of the circumscribed circle not covered by either the inner circle or star shall be blue; the colors to be the same shades as those in the American Flag. These insignia shall be placed on the upper and lower surfaces, respectively, of the upper and lower planes of each wing, in such position that the circumference of the circumscribed circle shall be tangent to the outer tips of the planes. One point of each star shall be pointed forward and unless otherwise specified the diameter of the insignia shall be 60 inches. The mark for the rudder shall be three equally wide bands of red, white and blue and both sides of that portion of the rudder which are in the rear of the rudder post shall be striped parallel to the vertical axis of the airplane. The blue band shall be nearest the rudder post, the white band in the center, and the red band at the rudder tail.

Our Domestic Flying Circus.—The three "companies" of the "Victory Loan Flying Circus" on May 10th ended 30-day tours at their home stations, after "playing" in 88 cities, in 45 States, and covering in "one-day stand" circuits totalling 19,124 miles. At each of these a standard "show" was given, scheduled for 1.30 P. M. Literature in the form of pasteboard bombs was dropped. Each package of 200 bombs contained one autograph of the Secretary of the Treasury. Photographs of the town were made and the negatives dropped by parachutes for such use as the loan committee might make. After ten or fifteen minutes of various exhibition flying, the Fokkers made a sham attack on the formation of Curtiss planes which were eventually rescued by the Spads and SE-5's, who drove down the enemy planes. The Spads and SE-5's then indulged in maneuvers and acrobatics. After these were finished and the machines landed, the Curtiss ships came down. Each circus had with it American, English and Italian "Aces." The enlisted personnel were from the famous 103d (Lafayette) 139th and 148th Squadrons. All three squadrons had meritorious records on the Western front and practically every enlisted man has had more than twelve months' service during active operations.

The First Government Peace-Time Order for airplanes has been placed by the U. S. Navy Department with a New York corporation for the immediate delivery of six special Loening monoplanes which are to be used by the Navy Department for shipboard observation use. Recent experiments started just prior to the close of the war, and continued for several months thereafter, have disclosed the remarkable efficiency with which fast high-powered airplanes can be used by the Navy for observation and spotting of gun fire of the battleships. The Loening monoplane, a new type of two-seater fighter, which was designed by Grover C. Loening, former chief aeronautical engineer of the Army Air Service, was accepted by the Government just prior to the armistice, and after official tests was found to be the fastest and best performing two-seater fighter in the world. Several records for speed and altitude have been broken in the official trials by Major R. W. Schroeder of the Army Air Service. The machines for the U. S. Navy will be so equipped as to permit of launching off the deck of a ship, as it has been found that the light monoplane type of machine can be accelerated very quickly particularly when equipped with a motor as powerful as the 300-horse-power Hispano-Suiza, which is being used on this type of aircraft.

Flax straw spread on the ground for one stage of the retting process

Harvesting a crop of flax-seed in Oregon

For Seed or for Fiber?

How a Faulty System Has Led the American Flax-Grower to Waste Millions of Dollars

By R. S. Skerrett

AN American linen industry has been urged repeatedly, but strange as it may seem, we have generally been rather indifferent to these proposals. Only a few months ago the Department of Commerce revived afresh this economic problem; and, if we are to take our logical place in the world of flax producers, now is the peculiarly favorable opportunity to launch forth upon a nationwide program to that end.

The United States Department of Agriculture has similarly discussed this important industrial question, and has carefully pointed out to our people that it would be well worth our while to make ourselves very largely independent of imported raw materials. The flax plant looms conspicuously among our agricultural products and, judged by acreage alone, we have normally ranked fourth in the area sown. Yet only an insignificant percentage of this total cultivation on our part has been put to fiber purposes.

Four years ago, according to the Government experts, we had 3,000,000 acres planted in flax, and of this only about 2,000 acres were devoted to the raising of flax for fiber. The rest was directed to the yielding of flaxseed, amounting in bumper years to between 28,000,000 and 30,000,000 bushels of this cereal. This crop we employed in the manufacture of linseed oil and the by-product, linseed cake. It has been our common practice heretofore to burn the bulk of the straw from the seed-bearing plants and to use the ashes to some extent as a fertilizer. There have been exceptions to this procedure, and the Department of Commerce states that there is an increasing amount of the better class of the straw being sold nowadays to tow mills throughout the Northwest.

These tow mills break up the straw and make tow, which is boiled and put into heavy papers or used for lining refrigerators in place of the charcoal and animal hair formerly drawn upon for insulating purposes. Some of this coarse tow serves as upholstery packing. The material, however, is quite different from the tow which is obtained by hackling operations in flax mills, and cannot be spun into yarn for weaving, so the Bureau of Foreign and Domestic Commerce states. Even so, we have in these uses of the flax straw an inkling of great savings through further adaptations of a material which, in the main, is wasted by burning. Indeed, it is declared that in making away with the straw in this manner the resulting ash does not ever compensate for the damage done to the ground, which is baked by the conflagration and rendered unproductive for several years thereafter.

According to the figures for 1918, we had sown to flax a total of 1,938,000 acres, and this yielded 14,657,000 bushels of the seed—being an average per acre of about 7.6 bushels. As a rule an acre of flax will give a ton of straw after the seed has been removed, which means that our flax growers had nearly 2,000,000 tons of straw to dispose of, and all but a modest percentage of this was burned on the spot. It is perfectly true that the flax raised for seed does differ from that raised for fiber. But even while the straw of the former has not the same high textile value of the latter, still the material is capable of yielding both fiber and other products that can be put to profitable account.

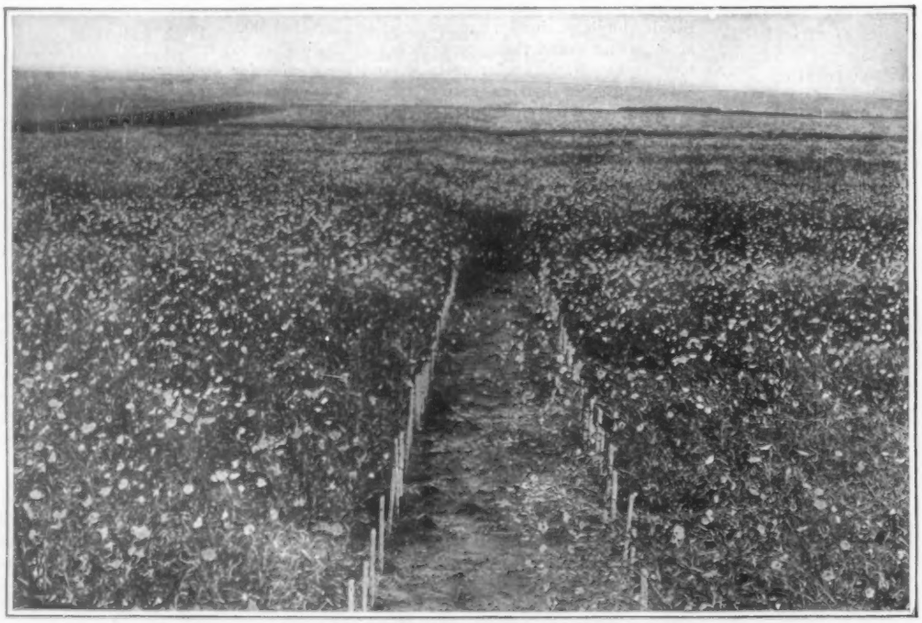
Analysis discloses that the run of the seed-flax straw contains quite 40 per cent of green fiber and, besides this, fully 50 per cent of woody structure or shive. According to these figures, we grew last year, and then burned up for the most part, 800,000 tons of flax fiber and 1,000,000 tons of shive. Experience has disclosed that 30 per cent of the fiber is long enough to be spun, while the rest of it can be worked into paper stock. For the short-length fiber the lowest market price is around 4¼ cents per pound, *i. e.*, $85 a ton, and allowing a quarter of a cent a pound for the woody material, *i. e.*, $5 a ton, we dissipated, by burning the straw, in 1918 substantially $73,000,000! Indeed, we did worse than that because quite 30 per cent of the fiber is long enough to be spun into yarns suitable for coarse linens, canvas, gunny sacking, carpet thread, ropes, twines, etc. This fiber is worth a good deal more than 4¼ cents a pound; and if we average it at only 10 cents a pound we cast to the winds an additional sum which would bring up the total wastage to $100,600,000.

The tow is especially suitable for nitration, as it contains 82 per cent of pure cellulose, and, therefore, is susceptible of being turned into explosives and pyrocellulose of a wide variety. The flax fiber, which is too short for spinning, can be used to advantage in the making of linen paper which now depends upon linen rags for its base—the rags coming to a very great extent from abroad. This fiber is also capable of being worked into fiber-board, tissue and wrapping papers, absorbent lint for surgical purposes, etc. The shive or woody substance can be pulped and substituted for mechanical or ground wood pulp, and to that extent relieve the drain upon our timber lands.

Three years ago, the U. S. Department of Agriculture issued a special bulletin dealing with the utilization of American flax straw in the paper and fiber board industry, and stated, among other things, "From an economic point of view it seems inconsistent that this country should import flax waste from foreign countries for paper and board manufacture and at the same time actually burn one and one half million tons of flax straw which it raises within its own borders. The rope, paper, and high-grade sack manufacturers have also been consuming an immense quantity of foreign raw material, in spite of the fact that it is well known that American flax straw is capable of being used for some of these purposes."

Thanks to American ingenuity, decoticating machines have been developed which have a capacity of half a ton of threshed straw per hour, from which can be obtained 300 pounds of long green tow suitable for spinning, 200 pounds of short fiber for paper making, and 500 pounds of wood or shive for woodpulp. Again, native genius has evolved chemical and other retting processes which do not impair the tensile strength of the fiber, while making it practicable to do the retting in a much shorter time than the operations can be carried out abroad by the methods commonly in vogue there. Therefore, there is every reason why we should go into flax raising for the manufacture of the finer grades of linen, and utilize at the same time and as far as possible the straw by-product of our flax-seed industry.

The United States is the

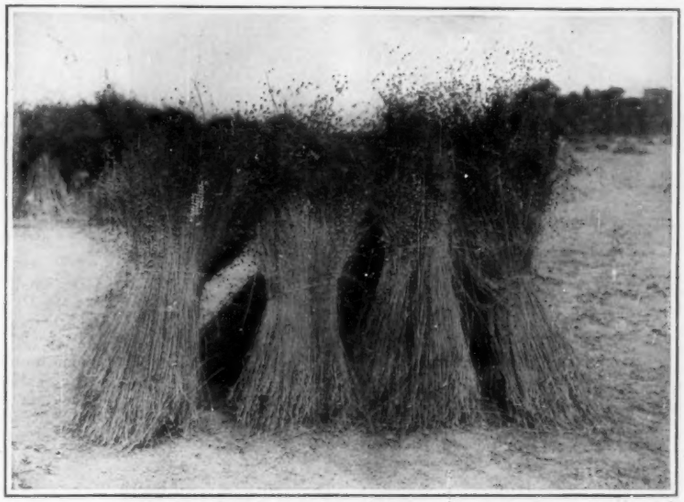


A great field of flowering flax in North Dakota raised for the seed

world's largest user of linen goods, but, with the exception of some crash toweling, most of our requirements are supplied from alien sources. It has been established conclusively by our agricultural authorities that the climate and soil in many of our States are adapted to flax culture, and the time is ripe for us to embark in a promising and even necessary venture. We are likely to be confronted in the near future with a shortage of linen, and conditions abroad plainly indicate that this is probably going to continue for some years to come.

The situation was summed up a short while ago by the Bureau of Foreign and Domestic Commerce, when it reported. "In the world's fiber flax market Russia has for long occupied very much the same position as the United States has occupied in the world's cotton market. The flax region of northern France and Belgium has also been very important. At present the customary production of flax in Europe is entirely deranged, and it looks as if for a long time to come there will be a distinct shortage of flax fiber. In England, in Ireland, in Canada, and in Japan flax acreage has increased. In the United States there has not been a great increase."

The point to be driven home is the need of conservation in our present flaxseed cultivation, and, by the more profitable use of the resulting straw, to obtain linen yarns which can be woven into textiles or worked into threads of various sorts and grades, while the short length fiber and the cortex are made to answer numerous requirements. We have thousands of spindles now engaged in turning out coarse linens, linen crash, etc.; and well nigh without exception these depend upon foreign yarns that could be just as easily manufactured here from the fiber of our flaxseed straw. Finally, by following such a course, we should at the same time create all of the essential machinery for spinning the threads for yarns called for in the weaving of the finer linen fabrics. Canada is striving diligently to foster a native linen industry, and her example, and conditions in Europe, should suffice to overcome the apathy in this field of endeavor which has so long prevailed here. Hundreds of millions of dollars are in the balance.



Shocks of flax before the seed has been threshed

Germany's Fall as a World Steel Power

THE secrecy which has been maintained by Germany regarding her iron and steel output since October, 1918, was recently broken and an analysis of the production reveals some striking features. In steel of all grades Germany reached her maximum output in 1913 at 18,894,241 metric tons. The largest war production was in 1917 at 16,587,360 tons. At no time during the war did the flow of steel from German furnaces approach the peace production, despite the fact that attempts were made to make the Allies think that records were being made. It is a fact that the coal production on which munition makers and steel plants depend, was only about 1,000,000 tons per month under the peace output but those well informed knew that the country could not maintain a pig iron and steel production equal to the pre-war rate. Under the conditions therefore the production of of over 16,500,000 tons was by no means a mediocre achievement. In the 10 months ended with October, 1918, the output was 13,756,813 tons and if this rate could have been maintained for the other two months, the year's production would have been over 16,500,000 tons.

By no means was the same ratio in pig iron output maintained as in steel. As compared with a peace output of over 19,300,000 tons in 1913, the largest war production was 13,284,738 tons in 1916. The striking fact that it was possible greatly to augment the steel output out of proportion to the pig iron under war conditions is probably explained by the use of tremendous amounts of scrap taken from Belgium and France in the shape of broken machinery and iron and steel in all manner of forms.

Comparing the 1917 steel output with that of 1913 it is notable that the Bessemer basic output declined over 33 per cent, due perhaps to a lack of pig iron. The open-hearth production was maintained at more than the relative normal peace output or 7,270,000 tons as compared with 7,600,000 tons in 1913. In crucible steel there was a marked increase relatively and here scrap steel was probably also an important item. The expansion in 1917 over 1913 was over 30 per cent. But the striking features of comparison are the changes in the electric and the steel casting output. The 1917 electric steel production was over twice that of the 1913, when Germany led the world in this phase of the industry. In steel castings however, the growth was remarkable under the conditions, the 1917 output having been over five times that of 1913 or 1,495,000 tons against 298,000 tons. The extent of this expansion is appreciated when it is remembered that the German steel foundry output in 1916, 1917 and probably 1918 exceeded that of the entire United States. To what extent the supply of stolen scrap was a factor in the electric and steel casting output is not known but it was probably important.

Perhaps never again will Germany occupy second place in the world's steel and iron production. The elimination of Alsace-Lorraine and Luxemberg means a drastic curtailment in the amounts credited to Germany and the quantity unavailable for inland consumption as a result of the allied occupation of German territory is by no means small: According to data already published for January and February, the present German output excluding Luxemburg and Alsace-Lorraine, is at the rate of about only 500,000 tons per month of pig iron and steel respectively. If from this is deducted its quantity produced in the occupied areas, the German steel output is at the rate of only about 5,600,000 tons per year and that of pig iron only 4,800,000 tons.

Michigan-grown flax, hackled and bundled ready for shipment

As a result of the war, then, Great Britain, occupies second place in the world's steel and iron output; and it is probable that France, soon after her resuscitation and rehabilitation, will not only outrank Germany but perhaps step into a position second only to the United States in the world's greatest industry.

Killing Vegetable Parasites with Poisoned Gases

THERE has been a marked increase of caterpillars and other plant parasites in the area of the war, during the last few years, an increase due partly to natural conditions and partly to a shortage both of labor and of insecticides. For this reason a French scientist, M. Gabriel Bertrand, has been making researches to find if some of the surplus chemicals employed as "tear gas" or "suffocating gas" may not be turned to purposes more innocent by being used as weapons against the insect world whose invasions are more threatening than ever in the present condition of near starvation of large areas of Europe. In his report to the French Academy of Sciences, M. Bertrand states that chloropicrin is particularly well suited to this purpose, since it is not only very active but keeps well and is obtainable at a low price from industrial by-products.

This substance is produced by the action of chloride of lime upon picric acid or even upon the residues which occur in the manufacture of this acid. It is a very mobile liquid of moderate refractive power with a density of 1.666 at a temperature of 16 degrees C. Its boiling point is 112.3 degrees C. at a pressure of 766 millimeters. It evaporates however, with great readiness, since it has a very strong vapor tension; this is 30.2 millimeters at a temperature of 15 degrees C. It is non-inflammable and only slightly soluble in water. In a state of great dilution in air it has an odor which is slightly aromatic and bitter; when more concentrated it becomes extremely irritating to the eyes and air passages, which causes it to act both as a tear gas and as a suffocating gas; furthermore, it causes violent coughing when breathed. It must be handled with precaution but since its aggressive properties are rapidly perceptible and disappear when it is sufficiently dilute it is less dangerous to man than hydrocyanic acid, for example, which is sometimes employed.

M. Bertrand studied the effect of chloropicrin diluted in given quantities of air upon various insects, seeking to determine by experiment the minimum fatal dose for each species, taking into account the length of exposure to the vapor, since the toxic effect is to a certain degree, more intense the longer the action is continued.

The experiments were conducted as follows: By means of a capillary pipette yielding small drops whose weight is determined by means of a balance, a known dose of chloropicrin is poured into a large-mouthed flask of a capacity of one or two liters. This flask is immediately corked and shaken vigorously in every direction to ensure an equal distribution of the vapor in the atmosphere of the flask.

At the end of a quarter of an hour the animals to be studied are introduced therein, from three to five being contained in a small bag of gauze; the thread tying the bag is held between the stopper and the neck of the bottle, so that the bag will remain suspended in the midst of the toxic atmosphere. At the end of a given period the animals were removed and examined and in case they were not dead they were placed to one side together with the leaves forming their usual food for the purpose of further examination. In the case of plant lice a small piece of the plant acting as host and covered with these parasites was placed in a small flask containing water, so that neither the plant nor the animals might suffer by reason of evaporation and this flask was suspended in the larger one, in place of the gauze bag.

Experiments were conducted with the caterpillars or larvae of certain Lepidoptera and Hymenoptera and with plant lice. The results obtained showed that an exposure of from five to ten minutes in an atmosphere containing not more than one or two centigrams of chloropicrin per liter is sufficient to kill these larvae and lice either immediately or after the lapse of a few hours. A concentration half as great was also very effective, at least in the case of the larvae, which stopped feeding, lost their strength and power of motion, and finally died in from twenty-four to forty-eight hours, after being exposed to the toxic vapor. A solution of chloropicrin is likewise very toxic to the infusorial paramecia and vorticellidae. The general conclusion, therefore, is that chloropicrin constitutes a valuable remedy for certain parasites of cultivated plants, being used either for fumigation or pulverized to form aqueous solutions or emulsions. It seems probable, too, that this substance would be of service for the partial sterilization of night soil.

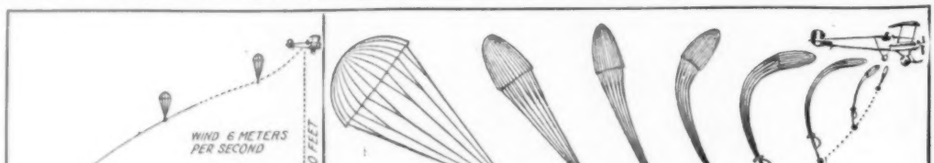
Nothing can wholly redeem the utter barbarity of poison-gas warfare; and therefore it might seem rather useless, to attempt to credit this advance to it. But even so a small entry on the credit side is welcome.

Parachutes for Airplanes

The Difficulties Which Have Prevented Their Adoption, and the Progress Made in Overcoming These

THE parachute has so long been used as a means of safe descent from balloons that one often hears wonder expressed that it should not be similarly employed with airplanes. This feeling is particularly poignant when the life of a man who has made good in other lines—such a man as the late Mayor Mitchel of this city, for example, is sacrificed, not in battle, where the game is so well worth the candle, but on the training field. The reasons for this failure to employ parachutes for planes are twofold, to put the matter in a nutshell—the greater rapidity and frailty of the heavier than air machine, together with its lack of self-sustaining power when not in motion and the greater need of its pilot for every ounce of energy and entire freedom of movement.

However, the ingenuity of inventors has long been directed towards finding a solution of this problem, and we here describe one of the most successful of these, the Calthrop parachute.



At the left, path of a parachute launched at height of 2,000 meters in wind of 6 meters per second; at right, diagram showing the manner in which the parachute opens

Some inventors have directed their endeavors toward the construction of a parachute sufficiently large to sustain not merely the pilot of an airplane but the machine itself, together with its passengers. This solution of the problem was difficult enough when the very lightest airplanes weighed from 300 to 400 kilos and the project has now been entirely abandoned. The airplanes of the present day weigh upon the average 1,000 kilos, hence to keep them afloat in the air with the falling speed sufficiently reduced for safety, would require a spread of canvas of from 700 to 800 square meters in extent. It is necessary, therefore, to confine the problem entirely to the construction of individual parachutes, which undoubtedly have a promising future.

At the very foundation of the problem the maximum speed of fall must be considered; practically speaking this should not exceed 3.65 meters per second. The following table gives precise and valuable information upon this point.

Weight Supported per Square Meter of Canvas	Speed of Fall per Second
1.000 kg.	2.80 m.
1.115 kg.	3.00 m.
1.250 kg.	3.20 m.
1.420 kg.	3.40 m.
1.660 kg.	3.65 m.
2.000 kg.	4.00 m.

The weight suspended by means of the parachute is equal to the pressure per square meter exerted upon the canvas. In calculating the required extent of a parachute the speed of descent does not enter into the question except from the point of view of the safety of the passenger. It must be borne in mind that for the moment the parachute is meant for the service of military aviators. When on service at the front the latter always fly very high, usually at a distance of from 2,000 to 4,000 meters above ground. Even at the former height the parachute would require, falling at a speed of 3.65 meters per second, 550 seconds or about nine minutes to reach the ground. But if at this moment the wind is blowing even only six meters per second, the aviator will be carried a distance of 3.33 kilometers. But it must be remembered that fighting planes are generally flying above the lines and since the prevailing winds in France are those from the west and the southwest it is evident that the aviator would be in great danger of being obliged to descend in hostile territory. In order to prevent such catastrophe it would be necessary to accelerate the descent of the parachute to a degree that would be incompatible with safety.

The problem of the rapid opening of the parachute presents two aspects. On the one hand the parachute must open with sufficient promptness to permit it to be used as near the ground as possible, while on the other hand it must not be allowed to unfold too near the airplane for fear of dragging the latter down with it. The two trajectories, that of the parachute and that of the abandoned airplane, are almost identical *at first*. This point must be attentively considered if we do not wish the remedy to be worse than the disease, so to speak.

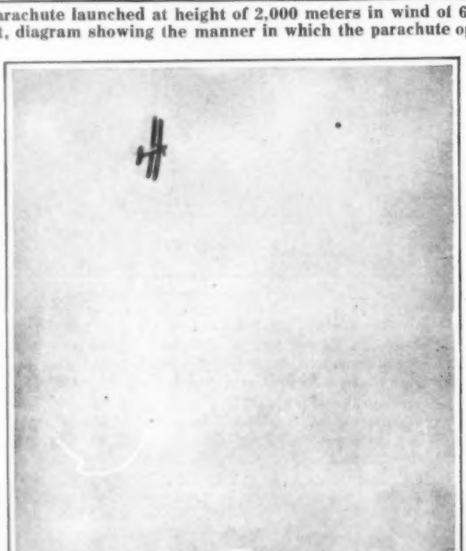
When the aviator is obliged to abandon his machine he should do so with entire confidence of a successful result. He must be convinced that his parachute will not remain attached to the airplane. The position occupied by the pilot does not usually faciltate the adaptation of a parachute to his machine. His seat is generally placed in front of or between the wings, just where the opening of the parachute is particularly difficult. When the pilot is placed at the rear of the *cellule* it is easier to insure the working of the parachute. Without going too deeply into this question it seems to be advisable that in nearly all cases the parachute should be fastened underneath the airplane towards the landing apparatus or parallel with the fuselage. It should be enclosed in a special frame and attached to the aviator by means of straps. This method consists, in fact, of an adaptation to the plane of the parachute used with balloons, not however without certain modifications. When a balloon is shot down its car always retains a nearly vertical position throughout the fall. An abandoned plane, on the contrary, turns upside down and under these conditions the release of the parachute is more or less contingent upon circumstances. Undoubtedly the best solution of the problem would be for the aviator to carry the whole safety apparatus—canvas, straps and belt—upon his back. But the total weight would become extremely irksome and there would be a risk of interference with the wearer's movements. However, such a system of individual parachutes was installed by the Germans in August, 1917, and seems to have given satisfactory results.

It is made of very pliant material and is fastened to the pilot's body. When the plane falls the pressure of the air causes the parachute to open and the wearer finds himself lifted from his seat. The device is supposed to deposit him gently upon the earth, but probably this happy result is not invariable. It is, of course, very important that a parachute should be able to operate whatever the position in space taken by the plane. This essential point is the one which presents the greatest difficulty to inventors. One of the first experiments with parachutes for aviators was made in August, 1910, by M. Gaston Hervieu, who experimented a little bit later from the Eiffel Tower with an ingenious device of apparent efficacy. In two tests the parchute opened in less than 15 meters and gently deposited its mannikin passenger upon the ground. Interesting models were exhibited later by other inventors, among whom we may mention Captain Couade whose device was capable of sustaining both the machine and its pilot. In February, 1912, an Austrian tailor named Reichelt was killed in experimenting with a parachute garment, whose supporting surface was evidently insufficient. To support a man of the average weight of 75 kilogrammes (165 pounds) from 50 to 60 square meters of canvas are required, while the garment of the unhappy tailor was only eight or nine.

Other experiments at the Eiffel Tower and elsewhere followed but no really convincing results were obtained till August 16th, 1913, when for the first time Pégoud leaped boldly into space suspended from a Bonnet parachute. His success encouraged others and successful experiments were made later with different types of parachutes by Messrs. Ors, LeBourhis and others. In July, 1914, The Union for Safety in Airplanes awarded a prize to M. Robert the inventor of an ingenious parachute which seemed to be efficacious.

The reader will naturally ask, after reading of such results, why the parachute has not yet been regularly supplied to the pilots of French planes. The fact of the matter is that these results which at first appear so conclusive are not so in reality. The conditions in which these experiments were made were absolutely exceptional. In the first place the experimenter occupied a place prepared in advance for the especial purpose of facilitating the launching and opening of the parachute. If the aviator had been obliged to jump into space from a machine which was upside down, or even merely beyond control, it is only too probable that the parachute would have failed of its purpose. Pégoud's experiment was in fact far more convincing than those which followed it, for the reason that it more closely approached actual circumstances.

Some of the most interesting and valuable experiments along this line have been made by an English inventor named Calthrop, who has devoted six years of study and experiment to the matter. He has succeeded in making a parachute which opens instantaneously in an entirely automatic manner and in which the falling distance required for unfolding is reduced to the minimum. The inventor first studied the reasons for the lack of success of his predecessors, finding that most of the failures came from the incomplete opening of the



The parachute launched in a calm, falls straight down instead of being carried off by the wind; it is then in danger of being wrecked by the falling plane

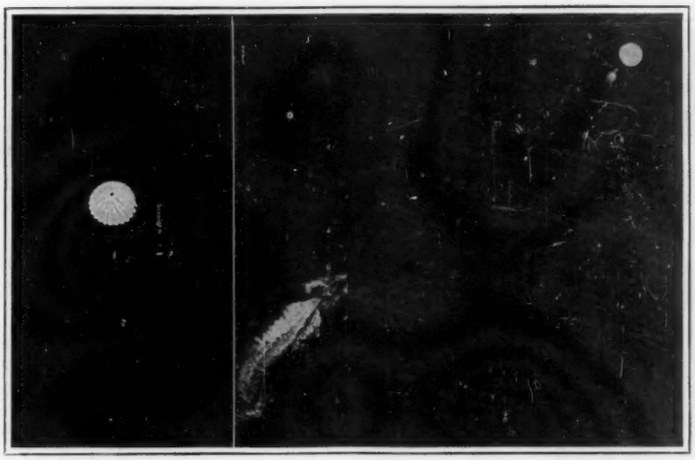
Parachute landing after descent from airplane

canvas and the tangling of the cables used for suspension. He was convinced that when the parachute failed to open it was because a vacuum had been created inside the canvas by the pressure of the external air passing through the central aperture at the top. It must be remembered, in fact, that a parachute left to itself is supported by a mass of air compressed within the pocket by the concave shape of the canvas. In other words there is a difference of pressure between the air which sustains the parachute and the external air. It is the pressure of the internal air which causes the parachute to open, consequently care must be taken to prevent a vacuum being formed inside the aforesaid pocket of cloth, since in this event the pressure of the outside air will tend to keep the device closed.

The Calthrop parachute is distinguished by having a certain quantity of air constantly stored within it and this favors its immediate opening as soon as it issues from the case within which it is folded. At the moment of issue the canvas presents the form of a cylinder terminating in a half sphere, the column of air contained immediately expands insuring the spread of the canvas to its full extent. The suspending cables are so arranged within the case which holds the parachute as to insure their unrolling without possibility of becoming tangled, even in the fiercest gale. Comparative tests conducted at the naval aeronautic station at Chingford, near London, with the Calthrop invention, for a period of two months gave excellent results. Launched from an airplane at an average speed of 120 kilometers per hour, it opened in a distance of less than 30 meters (100 feet). The height of the falling point was gradually reduced until it was possible to release the apparatus at only 60 meters (195 feet) and even at 42 meters (136 feet) above ground, without fear of a failure to spread. The load was increased from 50 to 75 kilos without inconvenience (from 110 pounds to 165 pounds). Furthermore the parachute exhibited no sign of wear and tear at the end of a very large number of experiments.

The descent of the parachute exhibits three phases. During the first while it is still folded it does not support the aviator, who falls like a log; at the beginning of the second phase the canvas spreads and checks the speed of the fall; in the third phase the device balances itself and continues to approach the ground at the reduced speed of 4.5 meters per second (15 feet per second).

In the second period the aviator is subject to a very considerable amount of strain, because of the sudden "*braking*" produced by the spreading of the canvas. To prevent this from being dangerous the aforesaid strain is distributed over the entire body of the aviator by a system of straps and belts. The parachute is also provided with an elastic shock absorber which seems to be quite effective.



A parachute descent as seen from above, and at the moment of landing on the water, with a boat in pursuit to pick up the aviator

The lateral movement of the parachute which is, at first, equal in speed to that of the airplane from which it was launched becomes gradually less until it entirely disappears, *provided the force of the wind is nil.* Strong gusts of wind, however, cause landing to be comparatively dangerous, since the parachute retains the horizontal speed of the wind, and for this reason it is important for the aviator to be able to free himself from the apparatus as soon as he reaches the ground, since otherwise he may be dragged like a child carrying a big umbrella in a gale.

The accompanying photographs show the inventor at the beginning of a successful leap from the top of Tower Bridge, across the Thames, before the parachute had begun to open, and at the moment of landing upon the surface of the river with the parachute completely spread.

[*The parachute invented by Lieutenant Ors has been recently exhibited by the inventor at Atlantic City. It is reported by the daily press as having been accepted by the French government and having been successfully used for some months. We are indebted for the information and diagrams in the above account to an article in the November number of La Science et La Vie (Paris.)*]

Powders

Some Characteristics of the Leading Military Explosives

By Lieut.-Col. Julian S. Hatcher, U. S. A.

THE dictionary says that powder is finely divided substance—dust. In time of peace powder may be dust, but in time of war powder is a very definite substance with a very definite shape and a very respectable and regular size. As I write, I have on my desk a full-sized cane made of smokeless cannon powder. It is about an inch in diameter, and about three feet long, and consists of a single stick of powder just as it came from the presses. It is brown, tough, flexible and nearly transparent, and looks very much like a big stick of horehound candy. If I should light it with a match, it would burn with a bright yellow flame, about as fast as celluloid does. I could easily light it and then blow it out again. For use in large cannon, the powder is cut into cylindrical grains about an inch in diameter and two inches long. I have seen a soldier light one of these grains with a match, light a cigarette from the powder flame, then blow out the flaming powder and put the remnant of the grain in his pocket. While it takes an appreciable length of time for a grain of powder to burn in the open air, it must be made to burn with extreme rapidity when it is used in a cannon, and in order to accomplish this, the smokeless powder used in large guns is ignited by an auxiliary charge of "black powder" which always burns with practically instantaneous speed, whether it is confined or not. Black powder is sometimes compressed into large grains of an inch or more in diameter, but it is a serious mistake to think one of these can be lighted and then blown out again, as smokeless powder can. I once saw a friend lay one of these grains on a metal plate and then try to light it. It has a hard, glazed surface, and at first the flame of the match did not take hold. Finally when it did catch it went off in an instant with a muffled report and a flash of fire that scorched his hand and eyebrows.

Black powder is the original gunpowder. It consists of pulverized charcoal, sulphur and saltpeter mixed together. Both sulfur and charcoal are inflammable, and if they are ignited they will burn as fast as air can be supplied to complete the combustion. When saltpeter is heated it gives off oxygen. By mixing with charcoal and sulfur enough saltpeter to supply the necessary oxygen for complete combustion, we obtain a mixture that can burn without the aid of air. As soon as sufficient heat is applied, the saltpeter gives off oxygen which burns the adjacent sulfur and charcoal, forming more heat, which decomposes the surrounding saltpeter, thus continuing the process. As the combustion does not have to wait for air to be supplied it spreads through the mass with practically instantaneous speed. During the combustion the sulfur combines with the potassium in the saltpeter (potassium nitrate) and forms a solid residue, which appears as a thick white smoke.

Invention of Gunpowder

While the Chinese are generally credited with being the inventors of gunpowder, a careful study of the subject

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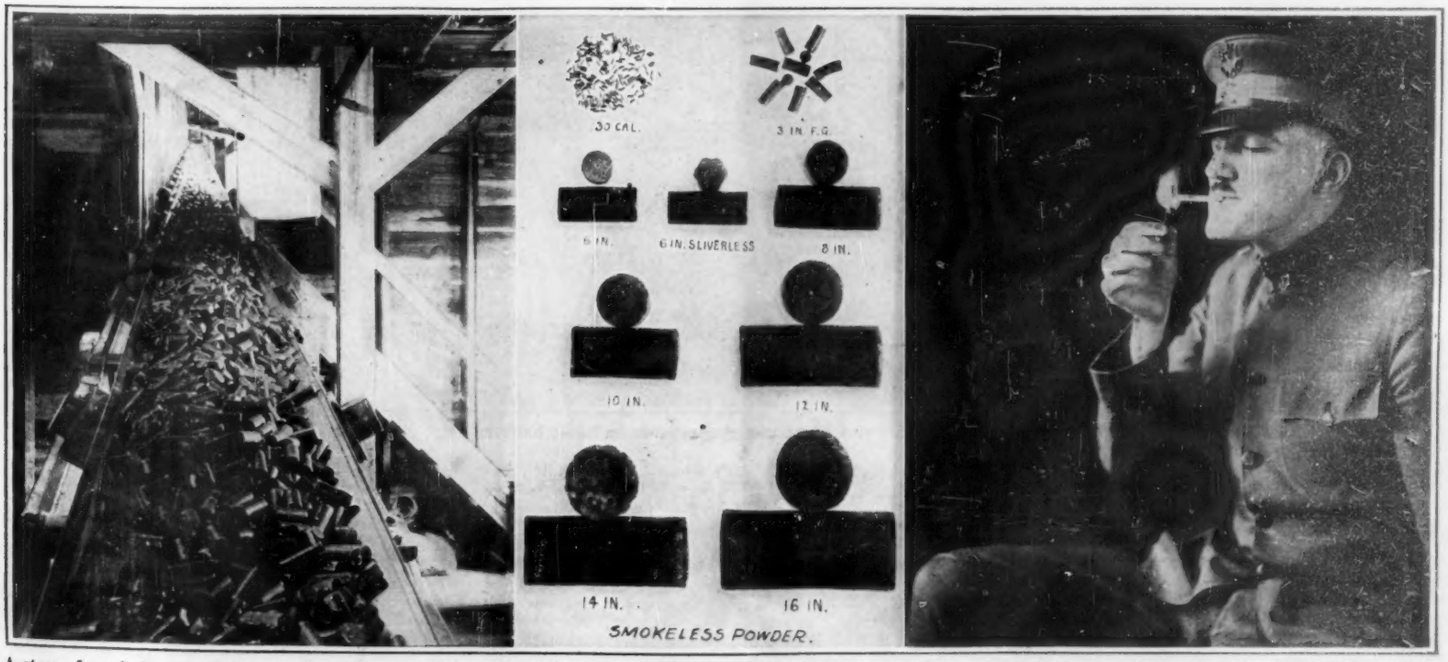
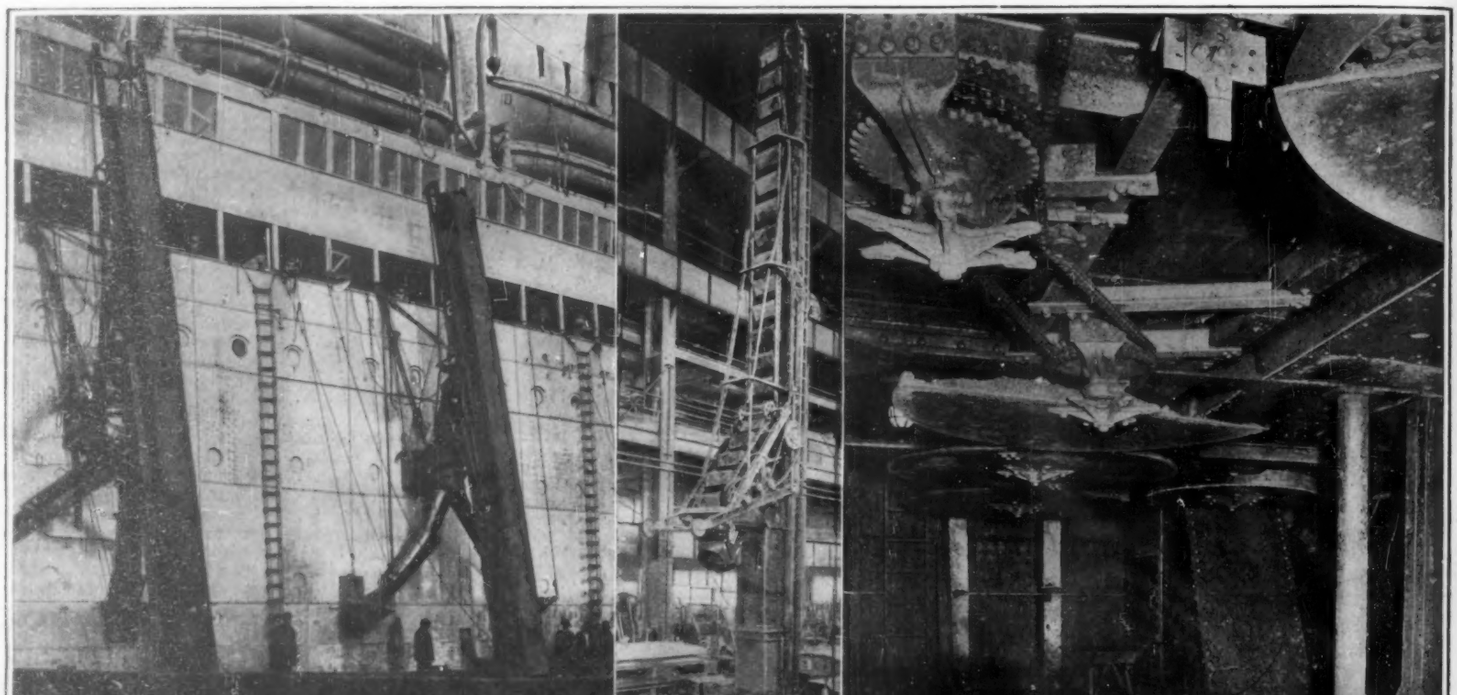


A store of smokeless powder "grains" used as propelling charge in large guns (left); a group of the grains of different shapes and sizes, for various guns (center), showing in each case the section also; and a demonstration of the slow-burning qualities of smokeless powder, in which a soldier uses a grain of this substance as a cigarette lighter



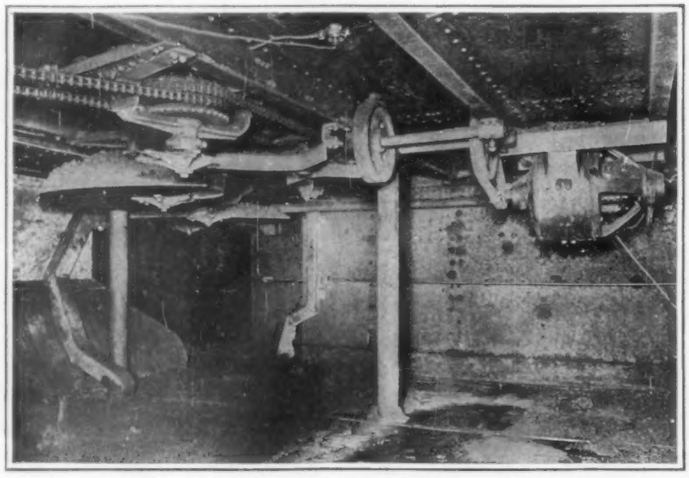
Three views of conveyor apparatus for moving coal from barge to bunker and distributing it evenly when it gets there

Bunkering Big Ships

Some of the Modern Equipment for Putting Coal Aboard Ocean-Going Craft

By J. F. Springer

THE bunkering of ships is a very important problem in the operation of sea-going vessels. One of the principal features concerns the time required to take on coal. The cost of keeping a ship in commission, whether in dock or on the sea, is so considerable that any unnecessary delays must be ruthlessly eliminated. The problem is, moreover, not everywhere the same. A sea-going vessel puts into Hampton Roads, Va., say, with the single purpose of filling its bunkers. The very same vessel enters New York Harbor, but the object in view may very well be two-fold. That is, the ship may come to load and unload freight and passengers and also to get coal. It will readily be seen then that coal-loading facilities quite suited to conditions at Hampton Roads may not be only unnecessary at New York but even ill-adapted. Perhaps one would not be far wrong in stating broadly that the character of the equipment at the leading ports reflects the character of the varying requirements. Thus, at Norfolk, aside from coastwise vessels and Navy ships, ocean-going craft can ordinarily seek but one thing, coal. The three coal roads which bring to Hampton Roads the splendid steam coals from the New River, Pocahontas and other fields have in service three great modern piers besides others not so up-to-date. These three piers are among the tallest in the world, two having their decks 91½ feet above the water and one 69 feet. The reason for these extreme heights is not the tidal variation, as that amounts to but three feet or thereabouts, but the desire to load big vessels alongside the pier. The coal is lifted in order that it may be dropped, downwards and outwards, and still pour into hatchways 45 feet above the water. The mode of delivery employed at these and similar piers may be properly termed gravity delivery. It has been estimated that the deck of gravity piers efficiently engaged in delivering coal to vessels of all classes should be from 33 to 43 feet above the highest hatch to be served. This vertical interval must provide for the storage facilities and the gravity flow in the chutes. The angle of repose for the particular coal or the particular material used in the chutes will be a factor here, as also the outboard distance from the side of the pier to the discharge point of the chute. Gravity delivery is probably very well suited to commercial conditions at Hampton Roads. However, at New York, the desire, not to say necessity, to combine bunkering with some other operation imposed upon a ship while in port, is perhaps responsible for the fact that there is here no tall pier. Sea-going vessels destined for distant ports do not, as a rule, get their bunker coal nor their cargo coal alongside the piers. The coal is preferably brought to the vessel while she is alongside a dock discharging or taking on passengers and cargo. I do not say that all ocean-going, non-coastwise ships get their bunker coal in this way; but for New York Harbor it is probably the most suitable. The barges or lighters which serve the big ship will naturally get their supplies from low piers by gravity discharge or from piers provided with car dumpers. In this latter case, the small vessel gets its load by very modern mechanical equipment.



Another view of the trimming mechanism in the bunker

At Philadelphia the piers are mostly low. However, the Pennsylvania R. R. has at Greenwich a tall pier 66 feet high at the sea end. At Baltimore, an effort has been made to coal ships directly from a low pier. This is an innovation made by the Baltimore & Ohio R. R. by means of a recently constructed pier at Curtis Bay. The coal is carried out on the pier by a belt conveyor. A transverse conveyor serves the hatchway of the ship alongside. Hampton Roads has already been mentioned. At Charleston, S. C., the Southern Railway has a recently built pier which may be described as a low pier, but I am not aware that a big liner could take on coal from it through its hatchways. At the same time, there is novelty in the construction and operation of this pier. The ship lies alongside. The coal is run out upon the pier in ordinary cars. These pass, one by one, upon the cradle of a movable car dumper which may be shifted on its own track to points opposite hatchways. The dumper overturns the loaded car sideways and the coal discharges into a hopper which forms part of a movable tower which shifts on a track parallel to that of the dumper. The hopper in turn delivers to a big hollow arm which reaches out over the hatchway. In the arm is a conveyor which operates by shoving. The coal is accordingly received and then pushed out over the vessel. The arm is adjustable as to height, particularly at its outboard end.

New York Harbor and the Port of Cardiff, South Wales, are the two greatest coal ports in the world, a total of perhaps 25,000,000 or 30,000,000 (short) tons of coal being transferred at each point from rail to vessel. However, a great deal of the coal received from the railroads at New York is for local consumption. Nevertheless, there is a very big tonnage that goes ultimately into the bunkers of the ships which come to the harbor. To deliver this coal expeditiously and at reasonable

cost to these vessels is a problem which has been only imperfectly solved—that is, it had not been completely solved until there came into use a new method which I purpose to describe in some detail. There is some reason to think that this method may be a very good solution.

By the new system, the coal is brought, say, by barges to points alongside the vessel. The ship may at the time be unloading or taking on cargo. If so, the coal is brought to the free side, or to a free section. By means of elevating conveyors, the coal is dug from the barges, hoisted to points somewhat above the port-holes arranged in the ship's sides, and then chuted to the holes. Here, the coal is received by permanent, power-driven equipment installed in the coal holds and there trimmed in place. This is a program requiring but few words to state. The actual realization of it in the form of equipment usable under commercial conditions and at a reasonable cost is a problem worthy of American inventive ability.

There are desirable modifications of the program which are usable upon occasion. Thus, it is not essential that there be a permanent trimming equipment installed in the vessel. The mechanism which delivers to portholes may be used alone, the trimming being left to hand labor. Further it is not necessary that the stream of coal being dug and lifted shall all pass to one port-hole at a time, as it is possible to provide for dividing the stream and simultaneously serving two holes.

The conveyor apparatus possesses a triangular head. This is temporarily secured to the vessel's side and remains fixed during operation. In this head is set the electric motor which provides the power. The controller may be set on the ship's deck. Here the single operator stands and controls all the movements. The controller receives its current from the ship's electric plant or from a supply line on the pier. Slidably secured to the head is a long framework containing the conveyor mechanism. This leg may be hoisted and lowered, through a considerable vertical range, relatively to the head. Accordingly, it is not necessary to reset the head, simply because the leg must be let down further as the recovery of the coal from the barge proceeds, or because the emptied barge must be removed and a loaded one brought into position. In the one case, the arrangements are such that the leg may settle automatically by its own weight as coal is dug from the load in the barge. In the other, the leg is hoisted up out of the way while the substitution of barges is being made. There is a sprocket wheel at each end of the leg and on these the bucket chain is mounted. The buckets themselves are secured to the chain and are suited in form both for digging and lifting. The motor when operated in one direction gives the bucket device its motion and power; when operated in the opposite direction, it effects the hoisting of the leg as a whole. Clutch dogs, arranged on the side, provide against the leg's sliding down during the stoppage of the motor preparatory to reversal. Hoisting of the leg may be necessary from time to time, in order to shift one and the same barge for the purpose of bringing unexcavated supplies of coal beneath the lower end of the leg. The one operator on the ship's deck suffices for starting up and stopping the conveyor and for hoisting the leg. The movements of the barges are naturally controlled by men having them especially in charge.

There is a telescope shield which is carried by the leg and which serves to cover the up-going run of the bucket chain. The function of this shield is to protect men underneath from possible stray falls of coals from the loaded buckets as they rise.

During the digging and conveying operation, the leg is free to rise and fall. Normally, it simply drops lower and lower as the coal level beneath its foot settles. But, there will be times when the foot has dug its way to a considerable depth, forming a kind of hole in the coal. This is apt to be followed by a caving-in of coal from the sides, resulting in a tendency to overload. The leg reacts automatically against this and rises, thus freeing itself from the congestion. This effect is due, no doubt, to the resistance to the down-coming buckets, now set up at a higher level by the coal coming in from the sides. The foot rises and accommodates itself to the new top of the coal.

A single conveying apparatus may be arranged to serve two portholes by making use of the two-way delivery head. This is especially useful where hand trimming is the method employed in disposing of the coal as it is delivered, for the reason that the capacity of the apparatus is far in excess of the ability of a single gang of men trimmers. However, the two-way delivery head is provided with a suitable gate, by means of which the stream of coal supplied by the apparatus may be all diverted to either one of the two ports. This is a serviceable feature, especially where one stowage space is larger than the other, or where for some reason it is necessary to stop delivery at one of the two ports. Such a necessity might arise because one trimming gang fell behind

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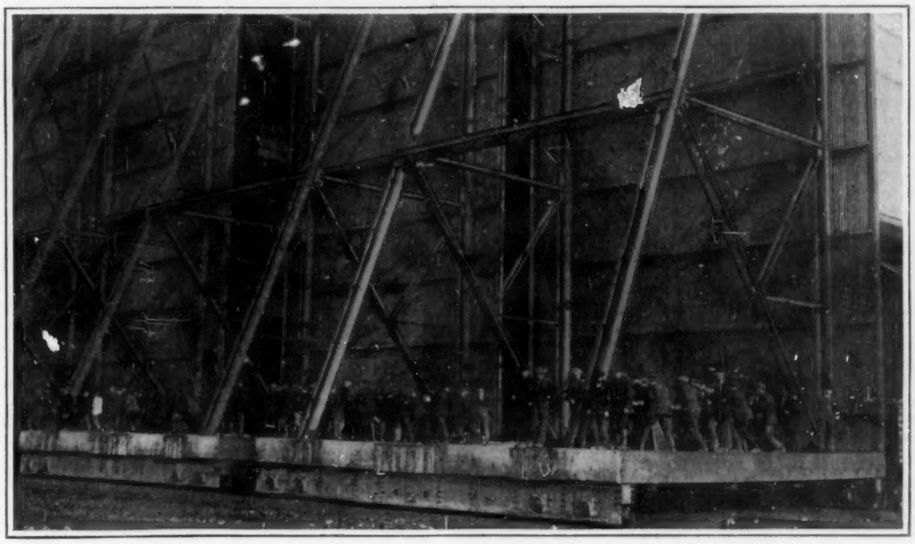
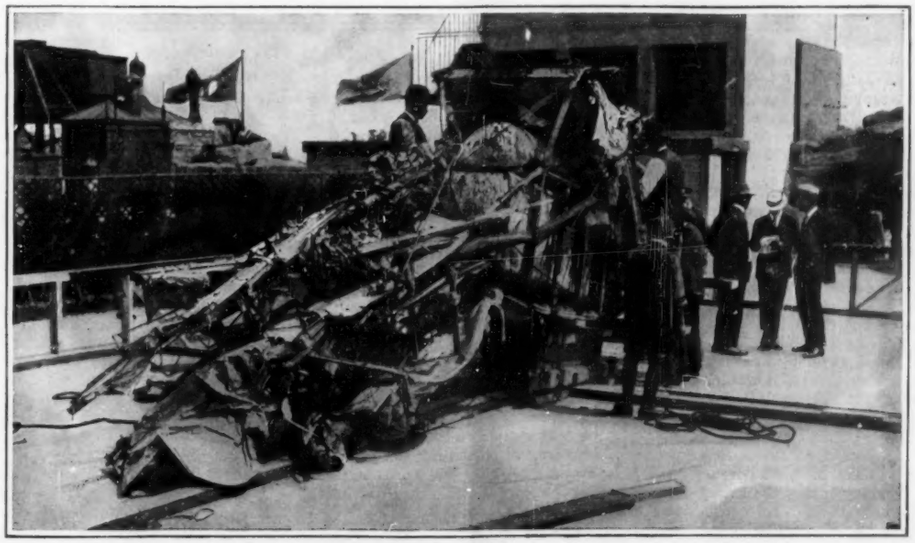


It requires many men to open the sliding doors of this huge hangar which houses the British dirigible R-33



Wreck of Hawker's trans-Atlantic Sopwith biplane which was taken to England by an American steamer

The House of the Giant Dirigible R-33

IT is one thing to design and build a huge dirigible of the rigid or so-called Zeppelin type, and quite another to house it. Indeed in the past, it has been the latter consideration that has prevented most governments from launching into the rigid dirigible competition.

When Great Britain decided that her navy had to have huge rigid dirigibles like those of the Germans, she set to work designing and constructing not only the machines but the shelters as well. The result is that today Great Britain has several large dirigible stations which include giant hangars quite comparable to those of Germany. The accompanying illustration of the sliding doors of a hangar for the R-33 dirigible gives some idea of the magnitude of the structure. The sliding doors are mounted on trucks which slide on rails. The doors are opened by a large number of men who operate the hand gear.

The High Cost of Tool Breakage

TO reduce tool breakage, a complete record of each broken tool is kept by a far western American steel company. When the tool is issued, it is accompanied by a tool damage report which must be turned in at the same time to obtain another instrument. This report also explains the cause of breakage and is sent to the machine-shop superintendent's office each day, where a record is kept of both tool damage and the division of cost against each shift and department.

The records are a convincing testimony to the expense of putting good tools in the hands of careless or incompetent workmen; and a charting of tool breakage shows that it is particularly heavy when numbers of new men are being put to work. Even in normal times the company found that the damage in tools is a big problem. It actually happened on one or two occasions that careless men destroyed in a moment tools far in excess of the value of their labor for weeks and months. But greater than the loss in money is the fact that it is in some cases almost impossible to replace at once many special high-speed tools that are destroyed. Breakage, therefore, of several important implements at about the same time compelled the plant to lay off a machine and hold up the entire progress of production. The amount of supervision necessary over such incompetent men is shown by the fact that before labor turnover became a problem last fall, two tool room clerks with eight assistants easily dispensed the equipment required by 500 men, whereas toward the end of the year 39 were required and 11 men were engaged solely on grinding the tools.

The Wreck of Hawker's Trans-Atlantic Sopwith

AS a photograph that tells a story, the illustration herewith of Hawker's Sopwith machine is exceptionally interesting. Here is the wreck of the machine in which Hawker and Grieve set out from Newfoundland on their flight to Ireland, and which they were compelled to bring down in mid-Atlantic. At the time of their rescue a heavy sea was running, so the machine had to be left behind by the Danish tramp "Mary." A short while later the wreck was picked up by an American steamer and brought to England in the condition shown in this view. How frail an airplane really is may be noted from the condition of the wreck, only the gasoline tanks of which appear to more or less intact.

The Farmer and the Patent System

How the Man Who Feeds the Nation Is Benefited by the Work of the Inventor

By Edwin J. Prindle

UNTIL recently that numerous and influential class of our citizens, the farmers, have in some sections of the country borne a feeling of enmity toward the patent system. There is no doubt that this feeling arises from an entire misunderstanding on the part of this intelligent class of our citizens as to the aims and purposes of the patent laws, and that this feeling of hostility has been engendered and increased by the unscrupulous acts of certain parties who have taken advantage of the protection of the patent laws to levy a species of blackmail upon the unsuspecting farmer. It will be interesting to review some of the benefits that the farmer has derived from the patent system.

The average farmer now lives nearly as well as did the most prosperous of his class in the old colonial days, so far as the necessities are concerned; and, as for luxuries, he has no end of conveniences and pleasures that were not to be had at any price in those days. But, as his prosperity depends on his earnings, let us compare the fruits of a given amount of labor expended in agriculture then and now.

Taking first the plow, which is one of the most important, if not the most important agricultural implement, at the time of the enactment of the first patent law in this country, in 1791, the plow was a wooden structure shod with iron, and it was so imperfect that but an acre of land could be plowed in a day, and even then it was not much more than scratched. The plow had hardly been improved at all in forty centuries. Now, the steel plow, with its greater strength and its perfected shape, digs down and overturns the soil so that a much larger crop is grown, and several times as much work can be done in a day with the ordinary one-horse plow as with the old form; while a steam-driven gang plow can plow twenty acres in the same length of time.

The harrow of the eighteenth century was simply a log having the spurs of its limbs for teeth. It was ineffective and easily broken. The modern harrow is mounted on wheels, and its well-shaped steel teeth are yieldingly supported, so that they may spring aside, instead of being broken, on striking a stone. It does thirty times as much work in a given time as did its predecessor, and, besides this, it carries its driver.

The planting of seed in rows and the cultivation of the plants that grew therefrom before the advent of the American inventor were done with the hoe. Now, the seed, with a measured amount of fertilizer, is accurately deposited and covered as rapidly as horses can walk; and implements which were never dreamed of by our ancestors thoroughly cultivate by horse-power the ground between the rows.

Of machinery for digging vegetables and harvesting corn, grain, and other crops, there is now such a variety that one is embarrassed to describe it, and yet it was all unknown one hundred years ago. The best implement for harvesting grain three generations ago was the cradle. This is a scythe having wooden fingers parallel to and above the blade to catch the grain as it was cut, so that it could be laid straight on the ground for ease in gathering it. A single man using a modern self-binding harvester will cut and bind twenty times as much grain in a day as he could cut alone with a cradle. These machines are sold for about the same price as a high-grade bicycle.

In thrashing by the use of the flail, which many persons living can remember to have seen in common use, four men could thrash twenty bushels of wheat in a day; while the steam thrasher of today, using the same number of hands, can thrash 1,000 bushels in an equal length of time. In fact there are steam-propelled harvesting machines on the Pacific slope that cut a swath 26 feet wide through a field of wheat, and the same machine at the same time thrashes, cleans, and puts the grain into bags at the rate of three bushels per minute; yet seven are all the men that are needed to run such a machine.

The prototype of the mower is the scythe, which has a comparative efficiency of one to twenty; and one modern horse rake is equal to half a dozen field hands working with the hand rake, which was the best implement the last century afforded.

The baling press is entirely an invention of this century, and yet, without it, hay could be profitably raised only near enough to the cities to be hauled in wagons, for it could not be shipped by railroad economically in its loose state.

In fact, there is so much machinery in use by the farmer of today for doing work that was done largely by hand before the advent of the patent system that this article would be altogether too long if all or even the principal instances were mentioned. While the farmer of the Revolution did most of his work by the unaided use of his hands, the farmer of the present time works by his brain through machinery which he has only to guide and to watch and most of which saves him the trouble even of walking.

This substitution of machinery for hand labor on the farm has relieved the farmer of other burdens than the mere drudgery. The use of hand labor before the patent system compelled the employment of a large force of laborers. Our comparatively short seasons required that the greater part of the force should be gathered in the spring and discharged in the fall to save wages through the long winter. It was with difficulty that men could be found at the desired time, and those of entirely unknown antecedents were gladly hired. This force was idle at intervals and again it required a considerable temporary increase. These men had to be housed and fed, necessitating the employment of female help, which is at all times difficult to secure in the country.

On the other hand, the introduction of farm machinery increased the power of a man to work to about ten times what it had been with hand tools, resulting in a great reduction in the number of hands necessary to operate a farm, and eliminating to a large extent the inconveniences of the larger force. Farm machinery is soon paid for out of the saving in wages and board which results from its use, and the cost of production is thus so greatly lowered that the American farmer is enabled to compete with low-priced hand labor in other parts of the world, while his profits at the same time are much increased.

MR. PRINDLE'S article on "The Farmer and the Patent System" was first published in the SCIENTIFIC AMERICAN *of March 18th, 1899, when the author was an assistant examiner in the United States Patent Office. Although the article is twenty years old it is still of timely interest and we have been asked by the Patent Office Society to republish it.*

The farmer's debt to the inventor is by no means fully appreciated, and that debt has grown considerably greater since Mr. Prindle prepared his estimate of it. The prosperity of our country hinges upon the resourcefulness and ingenuity of our inventors and a real appreciation of this fact should be reflected in Congress. The American farmer should lend his moral support to the improvement of the machinery for administering and enforcing the Patent Law.—EDITOR.

The case is parallel to that of the shoemaker and the shoe manufacturer. The shoemaker can profitably make expensive shoes to suit fastidious customers, but he cannot compete with the almost equally good machine-made shoes of the manufacturer in supplying the masses. No profits in general agriculture can be made where intelligent American hand-labor is relied upon to the exclusion of machinery. It has been the experience of trades repeatedly that, so long as there is no way to produce an article but by hand, cheap foreign labor supplies our own market; but as soon as we begin to make it by machinery we not only drive out the imported hand-made production, but sell abroad at a lower price than that for which the manually produced article can be offered. In this country, the wages of hand-labor more than eat up the profits. It is only in gardening that such labor can be economically employed by the agriculturist. To make general agriculture lucrative by hand-labor, it is necessary to go where Chinese, negroes and laborers of similar races may be utilized.

We cannot stop with the farm machinery, however, in enumerating the inventions produced since the patent system was introduced which benefit the farmer. When grain is hauled to the railroad, it is deposited in the cars or in the storage bins of the warehouse by a single movement of a lever; and at the great elevators of the large cities an entire train of cars will be loaded or unloaded in a single hour, thus doing in a small part of the time the work of an army of the shovelers of former days.

The modern mills make better flour and make it at a fraction of the cost of the last century; so that, as it is cheaper as well as better, a much enlarged demand is created for the grain from which it is made.

The dairy and canning machinery now in use not only replace an enormous amount of manual labor, but, by quickly converting the perishable milk into cheese and butter and by preserving the fruit and vegetables, they render profitable the raising of these products without reference to the distance from the cities. This was not formerly possible, because such forms of produce as these would spoil while being hauled to the market in wagons. The same advantages have accrued from the slaughtering machinery and refrigerator and stock cars with reference to the raising of live stock for meat.

Modern methods of refining oil and improved lamps have produced a light that is many times more brilliant than the old tallow dip of our forefathers and that is almost as safe.

The railroad is of the greatest service to the farmer, and here, too, the patent system is most intimately connected with its institution and development. The railroad ships live cattle and perishable fruits and vegetables from distances that would be impossible with the old methods of transportation, because such products would perish on the way, and, besides carrying more stable products, it brings the farmer his implements and fertilizers. In fact, if he had to haul all of his products by wagon, many large areas in this country could not be worked, because they are so far from the markets that the cost of shipment in the old way would be prohibitive. The railroad puts the farmer in touch with the consumer, no matter what distance may separate them. Indeed, the railroad and steel steamship open to the American farmer the whole world as a market. The steel steamer is much more economical than the wooden sailing vessel which it has supplanted, because it is several times larger, much safer, and faster than the sailing ship, and yet it requires a smaller crew and a shorter period of time to make a trip, resulting in a great saving of wages. The farmer gets the benefit of these differences in lower transportation.

Another invention which was developed under the fostering care of the patent system is the telegraph. By its use the farmer is often notified of the failure or probable failure of crops in other parts of the globe in time for him to supply the deficiency. Through the telegraph he is warned of storms which would destroy his herds, in time to take them to shelter—a proceeding that requires many hours on the great stock farms of the West—and of frosts, so that he may protect his small fruit. The telegraph, by giving frequent reports of the supply and demand, serves to keep the prices of the farmer's merchandise uniform throughout the entire country, excepting for the cost of transportation. He also knows the daily fluctuations of prices in the markets, so that he may choose the most advantageous time to sell.

These instances of the economy resulting from the use of machinery show that the resources of the farmer of the nineteenth century, compared with the meager earnings of his eighteenth century ancestor, are, to a great extent, due to the machinery which is at his command and which his forefathers did not have.

That this machinery has ever been invented is largely due to our wise patent laws, which will be apparent from the following considerations: The machinery which the farmer now enjoys did not exist before the patent system, but has been devised almost wholly since its establishment. Those who drafted the Constitution, with that foresight that has so many times evoked admiration when viewed in the light of after events, included a clause which was intended to produce just this result. The farmers of no other country are one-half so well provided with labor-saving machinery, and no other country has had, or now has, a patent system equal to ours.

The farmer labored for many centuries without machinery, and the patent system was instituted for the purpose (among others) of supplying him with machinery. Almost immediately after the enactment of our patent laws, agricultural machinery began to be invented and improved, and as this progress has continued and has steadily increased, it is clear that the patent system is the cause of the existence of the farmer's machinery and, through it, of his affluence.

Most of these inventions would not have been made if it had not been for the protection of the patent laws. To bring an invention from the general idea in the in-

(Continued on page 48)

RELY B ON ME

ONCE upon a time there was only one drop forging plant in all the United States of America. That was BILLINGS & SPENCER, of Hartford. Since that far past time (it was in Civil War days, and Lincoln knew Billings) other great plants have, of course, grown up and dotted the industrial map. But to many a keen buyer of drop forgings, of machinery, of hand tools, there is *still* only one drop forging plant in the United States of America.

W.D.T.

Rotating Projectiles from Smooth-Bore Guns

By C. G. Abbot, of the Smithsonian Institution

IN the late war much use was made of trench mortars. This kind of ordnance consists essentially of a smooth tube with a firing pin at the bottom. The projectile carries a shotgun shell at the rear. It is dropped down the smooth-bore barrel by the soldier and the firing-pin explodes the primer on the shotgun shell. This in its turn explodes the charge of propellant which throws the shell into the enemy's lines. Many of the trench mortar shells tumbled end over end as they went over, but some were provided with fins which retained them in approximately steady flight. However the trajectory of these shells was by no means ideal.

It occurred to me to try to secure sufficient rotation to produce steady flight by means of the turbine principle applied to the shells. Unfortunately the research was proposed to me only a few days before the armistice was declared so that by the time preliminary tests were made it was too late for the device to be of war service. However, the results appeared to be so promising that I have made numerous further experiments with a smooth-bore musket of nine-tenths inch diameter which had seen service in the Civil War.

The elongated ogival projectile was made in two parts in my experiments, the one a tough steel rear part chambered out to contain the propellant, the other an aluminum nose provided with a steel plug at the rear for screwing into the steel part of the projectile. The steel plug serves the double purpose of closing the chamber and attaching it to the front part. With the aluminum part in front such projectiles are particularly well calculated for tumbling, and invariably did so when fired in the usual manner. At the extreme rear of the steel part of the projectile a plurality of bell-shaped bores were provided, leading tangentially from the chamber within the projectile to the rear where they emerged into the barrel of the gun. On screwing the aluminum nose with its steel boss into the opening of the chamber the whole presented an appearance of an ordinary elongated projectile except for the bell-mouthed bores visible at the rear. When the gun is fired the propellant within the chamber is ignited by priming contained in the tangential apertures.

The outflow of the gases through the bell-mouthed bores, while they would give some rotation, owing to their friction within the chamber, would fail to give sufficient rotation if it were not that steel pins are inserted across the chamber to form a sort of baffle, so that the outflowing gases may react against this baffle and so tend more strongly to rotate the projectile.

It was feared that the combustion would not be completed, or at least that the gases would still remain in the chamber at high condensation at the time when the projectile left the muzzle of the gun. If this were the case it might easily be that owing to some slightly unsymmetrical construction of the bell-mouthed bores some tendency to deflect the flight of the projectile would be caused by the delayed outrush of the residue of gases. In order to avoid this, the end of the barrel was continued by a tube extending some 10 inches beyond the former muzzle and at the rear of the tube where it joined the barrel there were drilled a number of holes so that the gases might escape therefrom and relieve the pressure within the chamber of the projectile while still it was subject to guidance from the lengthened barrel of the gun.

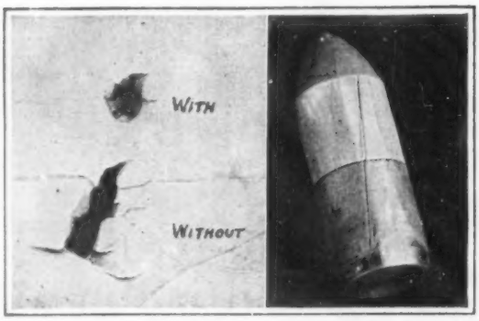
Very satisfactory results have been obtained in firing these special projectiles. This method of securing rotation of projectiles appears to be suitable not only for trench warfare but for all varieties of ordnance larger than one inch in diameter. Results as great as one rotation in 18 calibers have been obtained thereby. It is customary to employ about one rotation in 30 calibers in the ordnance of Europe. The United States employs one rotation in 25 calibers for a large number of its heavy guns. My experiments seem to show that one rotation in 40 or 50 calibers is sufficient to prevent any appreciable deflection of the shells in flight.

The experiments have been conducted within the enclosure of the Astrophysical Observatory, so that it was impracticable

(Continued on page 48)

Smothering a Fire Beneath a Combustible Blanket

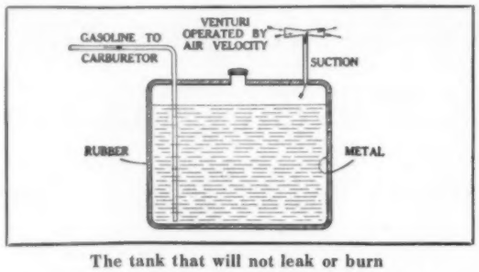
INVENTIONS of military importance which were held secret during the war are now being made public; and we may read of what American inventors have accomplished in their endeavor to bring about a victorious peace. One invention that demands particular attention is a gasoline tank which will neither leak nor explode, though it be pierced by repeated bullets.



The turbo-projectile that rotates; at left, the manner in which this shell and another without the rotating device penetrated a cardboard screen

The need of such an invention in aerial combat is obvious. When machine guns were first mounted on planes, the fighters quickly realized that the vital spot to be aimed at was not so much the pilot as the tank, which offered a much larger target. Once a hit was made here, either loss of fuel forced a premature landing, or the leaking gasoline when mixed with the current of air formed an explosive combination which ignited from the engine and set fire to the machine in mid-air.

Armor-plated tanks and compartment tanks to meet this were in turn rendered ineffective by means of armor-piercing and incendiary bullets. The tracer bullet, leaving a fine trail of smoke, guides the gunner's aim; the armor-piercer puts a hole in the tank; the fuel spills out and is ignited by the incendiary bullet. The three varieties of ammunition were fired alternately from the one gun, the magazine of which was loaded in advance, the order and number of the three types depending upon the errand to be undertaken. The compartment tank was now also useless, because the heat in a burning or exploding compartment fired the adjoining ones; while the use of a flowing elastic compound for tank walls minimized the tear in the tank walls but gave small protection against the incendiary bullet. The latter functions through the presence of phosphorus, which when mixed with the atmospheric oxygen of the air, will ignite any explosive mixture that comes in contact with it. To get an idea of the vicious character of these bullets, cases can be cited where some of the phosphorus became imbedded in tank walls beneath the fuel level; inoccuous for the moment because not exposed to the air, this charge would bring on an explosion hours or days afterwards when the fuel level fell below its hiding place.



The tank that will not leak or burn

This was the state of affairs when the United States entered the war. The problem was taken up by the Bureau of Standards, and the invention of Mr. F. Weinberg, a Detroit automotive engineer, was demonstrated in Washington in August, 1917. Through the cooperation of the Bureau and of the Science and Research Bureau of the War Department, the invention was taken up and brought to a high state of perfection.

The construction of the Weinberg tank is indicated in the diagram. Primarily it is an ordinary metal tank of any dimensions, having two connections and its filler cap. The suction connection is to provide a partial vacuum above the liquid, of sufficient strength to prevent its escape through any hole that may be shot through the tank wall. As anyone knows who has seen how an inverted tumbler full of water behaves, the force that has to be added to the external atmospheric resistance to balance the gravitational pull on a fluid is a slight one. The necessary suction can be got in various ways, but probably most simply by the venturi shown, which operates by virtue of the stream of air created through the very flight of the plane. For a standing tank, of course, some mechanical means of suction would have to be employed. The fuel reaches the carburetor through the second opening by overcoming the vacuum created through the former—which may be accomplished by maintaining a greater suction, or by positive feed pumps.

To insure proper functioning at all times, the tank is enveloped in some elastic material, analogous to the Zeppelin covering, which to a large extent plugs up whatever holes may be shot in the tank. Such substances are well known possessing sufficient elasticity to return practically to their former state after being pierced, leaving a hole so small as almost to defy detection. The tank may literally be made a sieve by hostile fire and still refuse to leak.

The application of this principle to render the tank leak-proof makes it at the same time explosion-proof. To cause an explosion there must be a combustible mixture of air and fuel; but in the Weinberg tank no such mixture can be created anywhere. A bullet piercing the tank below the level of the liquid is at once surrounded by the liquid and smothered. No air is in this part of the tank, and none can get in; there is no hole for air to pour in through, no leak where air and gasoline meet. The proposition of smothering a flame with a

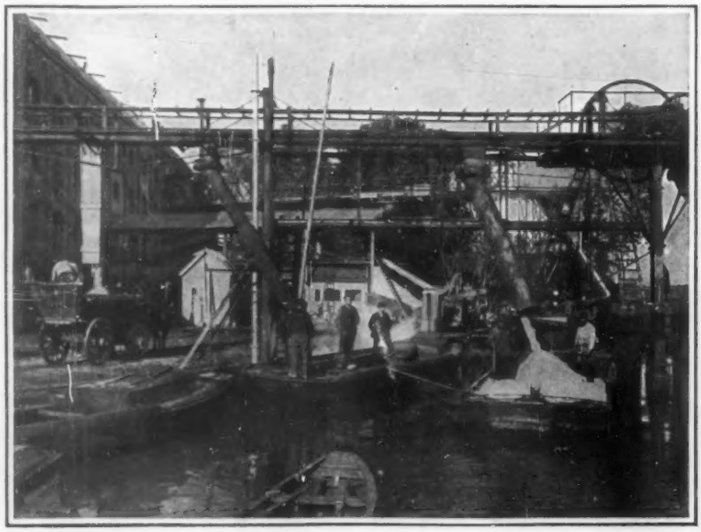
(Continued on page 48)

Paper Pulp from Holland

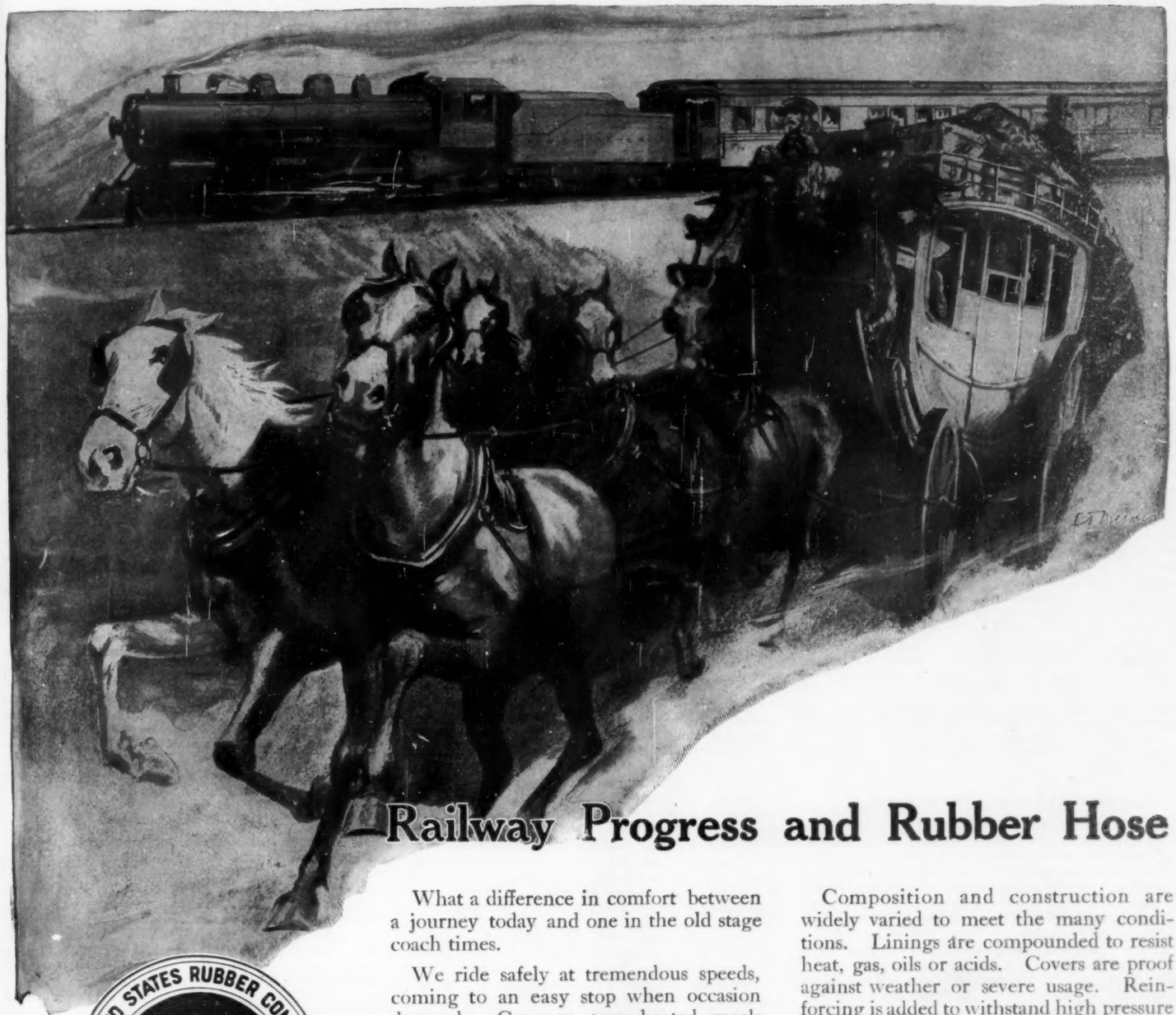
WHEN we think of Holland, we are little inclined to think of anything except a flat, treeless country, cut up by canals, and exposed to constant threat of overflow. It is true enough that all Holland is flat, that portions of it are below sea-level, and that it is about as highly developed, industrially and agriculturally, as any section of the world. But when we think of it as without trees, we are mistaken.

The fact is, there is enough timber in Holland to form the base of a considerable paper industry. About Amsterdam, in the northeastern arm of Holland, and down in the projecting elbow of Limburg which the Allies had some idea of taking away from Wilhelmina, are to be found centers of pulp manufacture. The trees, to be sure, are not from natural forests, but from plantations. Holland has in fact got to the point toward which the United States is headed; having long since exhausted her natural growth of forest, she has developed an artificial forestry, and no less than six per cent of her area is covered with these re-planted stands of trees.

In normal times, Holland uses up all her own paper and more besides. But during the extraordinary period through which the world has just been passing this state of affairs, like most others, has been turned upside down; England and France have looked to the little kingdom of the Dutch for a part of their paper supply, and on occasion the Netherlands has actually been able to help out the American market. Our illustration, in fact, depicts the loading of a cargo of pulp in Holland for the United States.



Loading paper pulp in Holland for export



Railway Progress and Rubber Hose

What a difference in comfort between a journey today and one in the old stage coach times.

We ride safely at tremendous speeds, coming to an easy stop when occasion demands. Cars are steam heated, meals gas cooked, and seats and floors vacuum cleaned.

Rubber Hose has made these possible.

The compressed air that stops the train passes through Rubber Air Brake Hose; Rubber Steam Heat Hose carries warmth from car to car; Rubber Gas Hose is used in charging the kitchen tanks; the dust and dirt is removed through Rubber Vacuum Hose.

Also Rubber Hose is used for filling engine boilers, loading and unloading oil tank cars, pumping, dredging and operating pneumatic tools. It is used for fire protection, hydraulic work, sand blasting, spraying—the uses are almost infinite.

Composition and construction are widely varied to meet the many conditions. Linings are compounded to resist heat, gas, oils or acids. Covers are proof against weather or severe usage. Reinforcing is added to withstand high pressure or powerful suction.

And the United States line includes them all. Rainbow Steam Hose, "4810" Air Hose and Anaconda Tank Hose are but a few.

United States Hose is used by railroads, other industries and individuals in enormous quantities. Because it has proved to be good hose in emergencies as well as in ordinary service, many concerns have made it standard equipment.

Take your hose problems to our specialists. The service you will receive is backed by the experience of the world's largest rubber manufacturer.

United States Rubber Company

UNITED STATES RUBBER COMPANY
US
RUBBER SYSTEM
AND ASSOCIATED COMPANIES

United States Rubber Hose is Good Hose

World Markets for American Manufactures

Edited by LYNN W. MEEKINS

A department devoted to the extension of American trade in foreign lands

Turning the World's Wheels

POWER—man and horse—has been consumed unsparingly for nearly five years in the business of war, forcing the world far behind its schedule in agriculture, industry and transportation. In making up this time the internal-combustion engine will supply much of the motive force. Operated on any kind of fuel that can be burned inside a cylinder—gasoline, kerosene, crude oil, and others—it is helping more than any other agency to get up the necessary speed. And the American engine is finding favor in many countries.

First of all, the world's larder must be restocked; in this the American traction engine will play the foremost part, its widest market being in those countries containing vast agricultural regions and lacking draft animals and human labor. It seems safe to predict that when Russia emerges from its present chaos it alone will buy enough farm tractors to keep American factories busy. Second, the world's industries must be supplied with motive power. Here is the field of the stationary engine, the most economical for the smaller workshops from which the bulk of the output must come. Its chief demand is in those countries where local industries are most prominent and extensive power systems depending upon black or white coal (by the latter is meant waterpower), are not accessible to the smaller manufacturer, workman or farmer. Eventually China should be the largest market for American stationary engines. Third, the world's agricultural and industrial products must be distributed with the utmost speed and efficiency. Deliveries are five years late—transportation must be as rapid as we can make it. Upon the internal-combustion engine, whether it be marine or automobile or airplane, falls the burden of bringing about this speedy service. American manufacturers exported more than $2,500,000 worth of gasoline marine engines last year and more than $4,000,000 worth of gasoline automobile engines. The transatlantic flight of the NC-4 is the best advertisement that could be imagined for the American airplane engine. Hail to the Liberty motor!

American Engines on Foreign Farms

Nearby are very good customers for our tractors and other farm engines. Canada is a heavy buyer; Mexico and Cuba are our best Latin American accounts. Some of the Canadian provincial governments are placing tractors at the disposal of farmers in various districts. In a section of Ontario, around Cornwall, a tractor burning kerosene or gasoline plows from 8 to 10 acres per day, or is used for thrashing, silo filling and other purposes, the cost to the farmer being only 35 cents per hour when he supplies the fuel. Stationary engines of one and two horse-power are found in numerous creameries. Much agricultural machinery is manufactured in Canada, but there is enough room for American equipment to make that country our largest market at present.

In Mexico, where most of the rural population has scampered to the cities and towns during the bandit era, there is urgent need for power machinery to cultivate the land. This was recognized by the Mexican government some time ago and efforts were made to stimulate the use of tractors by removing the import duty and lowering railroad freight rates between Mexican points. The caterpillar tractor seems to be giving the best results. A concession of 250 acres has been granted for an experimental farm in the state of Sinaloa to demonstrate the value of American farm machines, presenting an opportunity to American manufacturers who may rent parts of this land at a nominal cost and send experts to operate their engines, promote sales and educate the Mexican people.

Sugar is Cuba's specialty and the Cuban planter has found the American tractor so much better than slow-moving oxen that he is using it for plowing, hauling and in connection with cane-planting machines. On one estate, which had two caterpillar tractors at the beginning of the year, there are now six of these machines. To cope with the hard, sticky soil in the northern part of Cienfuegos Province the caterpillar type is better adapted; in the other parts, the round-wheel type is preferred. The sizes of the tractors employed vary from 8 to 16 and from 12 to 25 horse-power. During the late summer and the early autumn is the time to sell pumping engines in Cuba, where they are required for irrigation purposes in the dry winter season.

Features of South American Markets

The extensive wheatfields of Argentina provide the best opportunity in South America for the American traction engine. At present the most serious obstacle is the high cost of gasoline and kerosene, which has caused a preference for steam engines burning straw for fuel. Introduced in 1913, the gasoline tractor of from 30 to 40 horse-power produced excellent results, and in some years following more than 100 machines were sold; but the Argentine import duty, protecting the local petroleum industry, added too much to the rapidly increasing price of refined oil. For the operation of corn shellers and small thrashers many throttle-governing portable engines of 8, 10 and 14 horse-power are purchased by Argentine farmers. The popular type of small kerosene or gasoline engine has the make-and-break system of ignition and the hit-or-miss governor.

In the sugar districts of Brazil, near Rio de Janeiro, and in the rice fields around Sao Paulo there is a market for light tractors, which should be protected against deterioration from the prevailing dampness and provided with canopies to shelter the operators from the sun. There is no demand for tractors in the coffee regions. When the large tracts of prairie in southwestern Brazil are cultivated much American machinery will be needed. Portable steam engines have been used in Chile for some years, but gasoline tractors are replacing them, last year's imports making a new record. Peru is buying about twenty American tractors per month for use on sugar and cotton plantations and in rice fields. Stationary and portable gasoline engines are little known among the farmers of these countries. The agent of an American firm who travelled throughout Chile and Peru did not see any on the numerous estates that he visited.

European Sales Depend Upon Government Aid

Germany's submarines tried to cut off England's food supply, but the American tractor foiled them. The caterpillar family comes of fighting stock, and while the "he-caterpillars," or tanks, were tearing through the German line in France the "she-caterpillars," more peacefully inclined, but just as businesslike, were plowing thousands of acres of English soil to increase food production. The American tractor that did particularly good work in England was a light machine of high power, two-geared for road and pulling, and self-contained. Of course, the British government was the one and only buyer; and sales in the immediate future will probably be confined to government purchases.

Estimates of French needs in the way of farm tractors have run up as high as sixty thousand, so that the announcement by the French government of an absolute embargo on agricultural machinery, effective July 1st, was surprising. It is imposed in the belief that French manufacturers can supply the demand; if they can, they have made astounding progress since last November. A prominent American banker thinks, with many others, that the embargo will be short-lived. In Italy, however, the situation is different. About 6,000 American tractors had been delivered to the government up to the middle of March, and outstanding contracts with Italian firms called for 15,000 more. This market is well supplied for the present.

One American manufacturer recently charged nearly $25,000,000 to losses incurred in Russia. That large sum is significant in its relation to the formerly profitable agricultural machinery business with that country and to the future possibilities of trade extension there. In 1916 the Russian Department of Agriculture ordered 40 American tractors, which were readily sold to landowners; an order for 100 more followed. The sizes were from 8 to 10 horse-power and 60 horse-power, intermediate types not being suitable.

Upon the financial arrangements made by various European governments for buying agricultural machinery depend the volume of business that American manufacturers may expect within the next few years. Last year the Greek government ordered 15 motor plows and 200 tractors from the United States. In 1917 the Portuguese authorities purchased 28 American tractors, of which 21 were light (from 12 to 25 horse-power), and seven heavy (from 25 to 50 horse-power). Norway, too, is trying out our modern power machinery.

Opportunities in the Antipodes

In most of the Oriental countries there are so many people and such small land holdings that the market for farm engines is very limited. It is in Australia and New Zealand that the American manufacturer of internal-combustion engines of every description is finding the most orders at present. More than 80 per cent of the cultivated area in Australia is suitable for tractors, which are needed chiefly for work in the wheatfields. Although machines of from 12 to 20 horse-power are the most popular, there is a good scope for larger sizes. In every case quality is more important than low prices. The difference in the cost of gasoline and kerosene in Australia is less than it is in the United States, but kerosene engines are preferred.

The gas engine has been consistently in demand in Australia during the past four years. If the necessary fuel were equally accessible, it is likely that the use of the gas engine in that country would be relatively as extensive and varied as it is now on American farms. "Almost every kind of internal-combustion engine made is sold in Australia," said a merchant from Sydney. "The types include vertical and horizontal engines in sizes from 1½ to 15 horse-power, with the 4 to 6 horse-power size leading the demand. Engines like those sold to farmers in the United States are steadily called for. These may be classed as the intermediate type, selling at a medium or moderate price. Several thousand gas engines are needed to run the interior mechanism of stripper harvesters and binders. Australia employs high-class engines for dairying, irrigation and other purposes, most of these coming from England. Because of the hot summers and the high percentage of minerals in the water found in various parts of Australia, American engines should have efficient cooling devices and accessible water-jackets to permit of easy cleaning."

The United States has supplied most of the farm tractors used in New Zealand, where it is said that the four-wheel type is best adapted. Many hundreds of gasoline stationary engines of from 2½ to 4 horse-power are now being sold in New Zealand annually for use in connection with milking and sheep-shearing machines. This should be taken into account by the American manufacturer in appointing agents, firms dealing in such equipment being the best representatives because gas engines are very largely bought in connection with it.

Helping Chinese Industries

The heir to a fortune is not always—or usually—inclined to work, until he loses it. Many countries that depended upon imported goods until the war interrupted the world's commerce have had to supply their own needs in numerous lines. A conspicuous example is China, where many new industries have been started in the last few years. The usual procedure is for the Chinese business man to furnish the working capital and foreign interests the invested capital in the form of machinery and supplies, the enterprise being of a joint nature.

Amoy is the center of a large emigration district. Many natives of Fukien Province go away to seek their fortunes, which they have been remarkably successful in finding throughout the Orient. Upon returning to Amoy, they want some of the modern conveniences enjoyed during their absence abroad, including, for one thing, electric lights. All over South China small electric light and power plants have been introduced and have found it economical to operate with gas engines. In the district to Canton, Hongkong and Swatow, a number of internal-combustion engines have been installed, the fuel being crude oil from Borneo and Sumatra.

"Because the crude-oil engine can show a higher operating efficiency in small units than a steam plant, the semi-Diesel engine is likely to have a continually increasing sale in China," said an American engineer recently. "I believe that American equipment of that sort can be sold in China in competition with other makes, but the true Diesel is handicapped by its high cost per brake horse-power."

There are so many kinds of internal-combustion engines for so many uses that the success of the American manufacturer in selling them abroad will be directly proportionate to his ability to size up his foreign customers' needs and to meet a great variety of conditions. Above all comes *service*—the amount of service obtainable from each engine and the amount of service with which the manufacturer will back up each sale. This is best accomplished by appointing experienced machinery firms in different countries as agents and assigning well-trained engineers to work with them regularly or periodically.

A Fire Insurance Policy Is Only the First Step Only One Precaution

Here is a history of a typical fire.

The main building burns. It is what insurance companies call a total loss. The full amount of the insurance is paid. But there stands the ruins. They must be carted away. They are good for nothing. Some of the out-buildings still stand but they are of no use without the main building.

Such a place is worse than unimproved property. It is dead property. Until it gets back to something like its original state, it is retarding the progress and growth of that town. If you think for an instant that insurance money fully covers a fire loss, you need a different point of view.

Any man who would rather have his fire insurance money than have his property intact from fire is a menace to the community.

Only when every member of the community is impressed with his responsibility for the loss that fire causes will every precaution be taken against fire.

The fire prevention service the Hartford Fire Insurance Company makes possible to you is the greatest benefit you buy with your insurance money.

A fire insurance policy is only one step—only one precaution. Payment for the property destroyed does not fully recompense the loser—he loses more than mere value—his business is stopped—his plans are spoiled—he suffers from delay—annoyance—distress and loss of sales.

Ask your local Hartford agent to tell you what the Hartford does to prevent fires and how you can avail yourself of this service.

Any agent or broker can get you a policy in the

HARTFORD FIRE INSURANCE CO.

The Two Hartfords—the Hartford Fire Insurance Co. and the Hartford Accident and Indemnity Co. write practically every form of insurance except life.

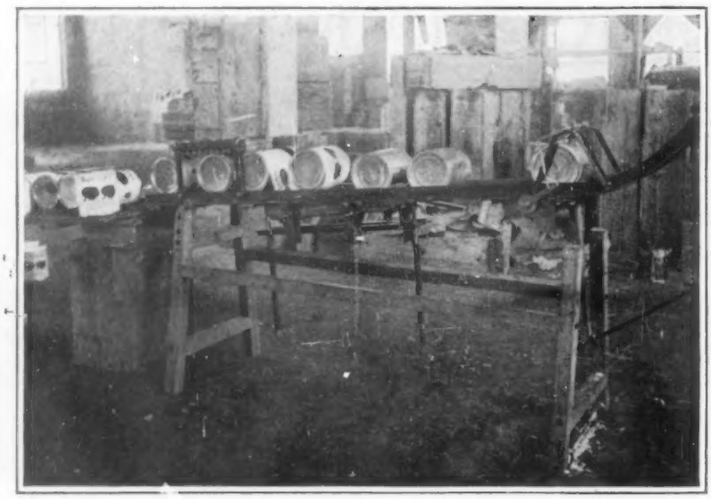
HARTFORD FIRE INSURANCE CO.
HARTFORD ACCIDENT AND INDEMNITY CO.
Hartford, Conn.

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Arts

Pasting Labels by Gravity

THE gravity labeler marks a wide departure from all previous belt machines as one of extreme simplicity. Starting from a receiving shelf, the cans roll down an inclined track, passing first over an open tray of adhesive and then over the label stack, picking up a label in their progress. The cans then pass under a battery of brushes, thus firmly affixing the labels. The machine will work at lightning speed, being limited only by the rate at which operatives can place cans on the inclined shelf. It will take cans up to the one gallon size, and is the only labeler of any kind which will handle the large size cans.



The machine that puts the cans on the labels

Safe Handling of Acids

COMMERCIAL acids are used in many manufacturing operations, as for example the cleaning of small castings and metal parts, the silvering of mirrors, the manufacture of storage batteries, and in the plating, soap-making, dye, rubber and other industries. Where acids in quantity are employed, safe carrying devices for the handling of the carboys are in familiar use. But a number of operations require only small quantities of acid, frequently less than a carboy. In such cases, there is considerable danger to the operator in the hazard of accidentally breaking or upsetting the vessel containing the acids.

It is to meet this condition that the acid container illustrated herewith is designed. The jug which directly holds the acid fits into a cylinder of fiber or sheet metal, the space between the two being filled with a tarry composition. The jug is thus held securely in its container, and given a somewhat more positive equilibrium than it would possess if standing on its own bottom. A strong handle for carrying the outfit from place to place completes the design, which has the endorsement of the American Museum of Safety.

The spill-proof and splash-proof acid container, with the cover on

The safety acid container with the cover off, showing packing around the jug

Latest Patent Decisions

THE patent in suit is intended to give practical effect to the idea that, by producing a strapping which could be applied by nails driven obliquely therethrough, the oblique driving of each successive nail would take up the slack between it and the last driven, and that such accumulative tightening would cause the strapping to hug tightly to the box, thereby avoiding the danger of the box breaking open. The inventor arranged to corrugate the median portion of the strap transversely, so as to form a central web portion having alternate ridges and furrows, the latter forming effective nail-receiving pockets, and the former constituting effective nail-holder shoulders or abutments; the idea being that a nail held obliquely could be safely driven without danger of glancing, the puncturing blows being utilized to take up the slack. The effect of corrugating the median portion is to increase the over-all thickness of the web portion, so that, to the extent the overall thickness is increased, so also would the depth of the pockets and the height of the nail-holding ridges be increased, without respect to the thickness of the metal employed. The corrugation of the metal maintains the thickness and thus affords a sufficient resistance to puncture by the nail to enable the blows to perform the slack taking-up function before the strap is actually punctured, and it is claimed that thin sheet metal can be used for wide strapping. By driving the nail obliquely it enters the wood obliquely, and thus will continue further to take up the slack insuring that the strapping will be caused to hug snugly upon the box. The side border of the strapping is left uncorrugated transversely, and thus avoids the danger of the sudden taking-up of the slack which would be caused by the stretch of the strapping longitudinally and thus defeat the purpose of the invention. The transversely corrugated central web, with its uncorrugated borders, comprise the central idea of the invention.

Held, that the patent is not invalid and was infringed.—*Stanley Works v. Twisted Wire & Steel Co. U. S. C. C. A. of New York.*

What is practically lard, consisting solely of one vegetable oil in a state of arrested hydrogeneration, the product covered by the Burchenal patent is a new thing in the sense of the patent law, and not a lard substitute, so near to existing articles of commerce that the only field open to patentee was limited to a particular mode of making, or by specifically stated chemical tests. This patent for a homogeneous lard-like food product, consisting of incompletely hydrogenized vegetable oil or cotton seed oil, held, valid, and to show invention, despite the contentions that the matter is so obvious as not to rise to the dignity of invention—that the process of hydrogenating oils was already known, and that a similar product had been previously produced by the mixture of cotton seed oil and animal stearin.

It is immaterial whether a patentee understands or correctly states the theory or philosophy of the invention, or understands all of the phenomena leading to the result. Such does not, in an infringement suit, tend to show or to prove that he was not the inventor.—*Proctor & Gamble Co. v. Berlin Mills Co. U. S. C. C. A. of New York.*

This action is upon the claims of two patents both issued to the plaintiff. The general subject matter of both patents is commercially known as prepared roofing consisting of a "felt" made of paper stock impregnated and coated with a waterproofing material, usually asphaltum, and covered on the side intended to be exposed to the weather with mineral particles of many kinds, sand being in commonest use for the purpose.

The object of the invention was to produce a design upon the roofing material simulating slate, and thus relieve the dull uniformity of color and surface which impaired the marketability of the plain product. The only means of producing "areas or lines of contrasting color" is to apply heat or pressure or both to either said areas or lines and thus embed the mineral covering of the asphaltum coating more deeply in the coating within the lines or areas subjected to heat and pressure. A Mr. Becker, of defendant, claims priority in the same invention.

Held, that the Bird patent, or that of plaintiff, is valid and not infringed, and that a broad claim does not extend invention, and that if defendant patentee discloses one means, a statement that he does not confine himself thereto will not justify a claim covering all means.—*Bird v. Elaborated Roofing Co. of Buffalo. U. S. C. C. A. of N. Y.*

Plaintiff in this case is the owner of certain patents having to do with the construction of caissons, and has brought the usual suit for infringement against defendant for permanent injunctive relief.

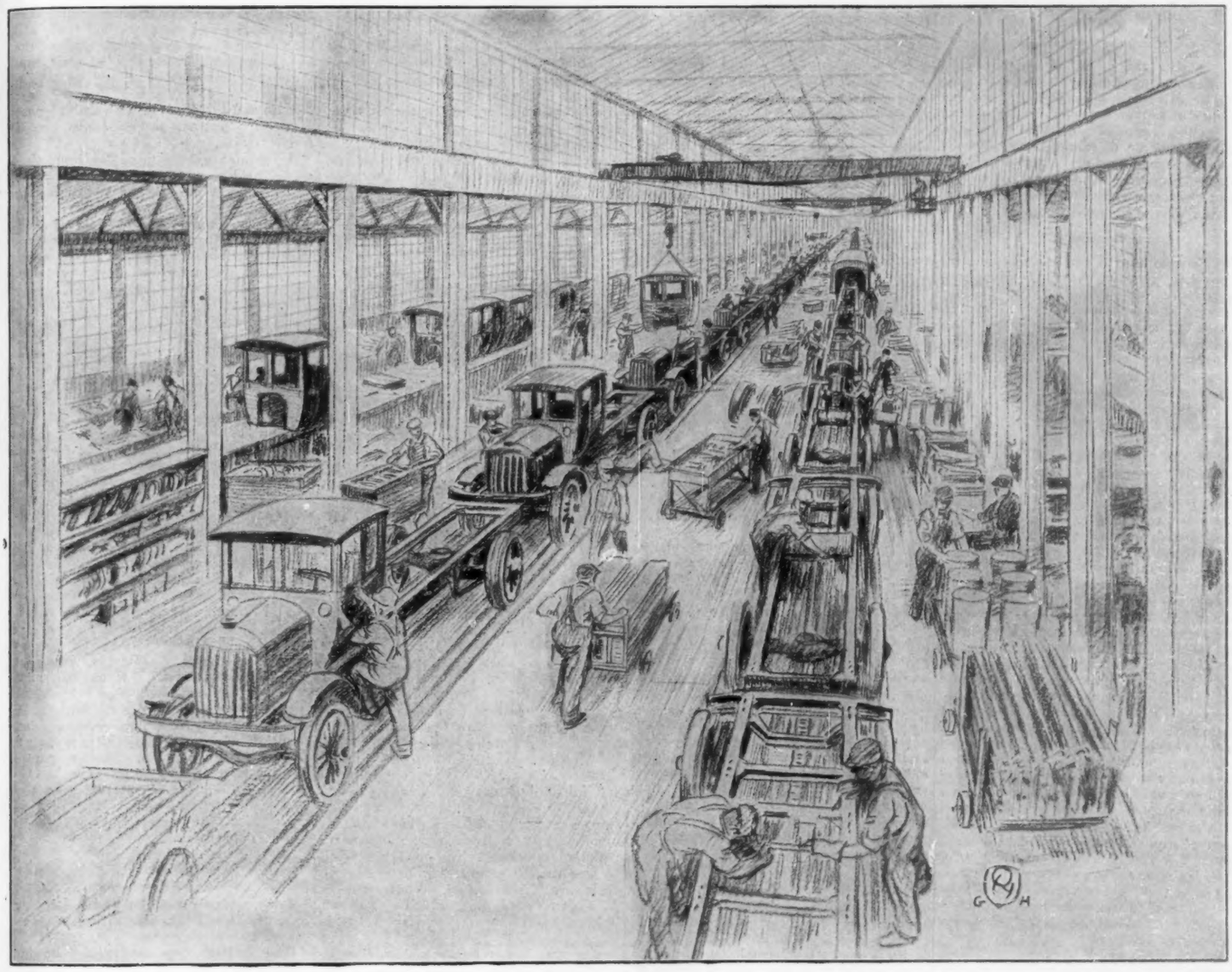
The caissons said to infringe are being sunk as parts of the foundation of the new United States Assay Office, now in course of construction at 30 Wall street, New York, for the United States Government, under the direction of the Treasury Department, pursuant to contract.

Defendant is the sub-contractor for the building of the foundation for this new Assay Office, and the caissons are being constructed as parts of such foundations. Two caissons have been completed and are ready to be sunk, and other caissons are in various stages of construction. When sunk to bed rock, the caissons become parts of the foundation of the building.

It is plain that an injunction, if now issued, would seriously delay the construction of the public building in question, and it is therefore held, that whenever a patented invention shall be used by or for the United States without a license, the owner's remedy shall be by suit against the United States for the recovery of his reasonable and entire compensation, and the court will not grant a preliminary injunction to restrain the use of a patented invention by a contractor in the construction of a Government building.—*Foundation Co. v. Underpinning & Foundation Co. U. S. D. C. of N. Y.*

Measuring Tree Growth

Apparatus for measuring the growth of trees consists of an invar tape which is passed around the tree and over the "rockers" on the apparatus, the arms of which control the angle between a plane glass surface and the face of a right-angled glass prism. The growth of the tree is measured by observing the change of position of the interference bands formed, at grazing incidence, between the plane and the prism.



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Powders

(Continued from page 33)

shows that the origin of gunpowder is shrouded in uncertainty, both as to time and as to place. It appears that the discovery of saltpeter was followed by its use in making incendiary mixtures for use in warfare. Some of these merely burned fiercely, but others developed mildly explosive properties, and these led to the development of gunpowder, which was well known by the thirteenth century.

Guncotton

This substance is the basis of modern smokeless powder. It was discovered in 1846 by Professor Schoenbein of Basle. It consists of cotton which has been subjected to the action of a mixture of nitric and sulfuric acids. After this treatment the cotton looks much the same as it did before, but it is very much changed in its chemical structure, for it has become one of the most violent of explosives. The sulfuric acid has extracted some of the water molecules from the cotton fiber, and the nitric acid has replaced them by a molecule containing a large quantity of oxygen. The combination which has been formed is an unstable one. It is solid in form, but each of its molecules consists of elements which could easily be rearranged into several molecules of stable gases. If the guncotton receives just the right kind of shock, all the molecules will rearrange themselves in the manner indicated. This action of rearrangement of molecules progresses through the mass of explosive in a wave action similar to the manner in which sound is transmitted through the air. As the wave passes each molecule which is in unstable equilibrium, it rearranges itself into several molecules of gases. The explosive wave passes with extreme rapidity (about 16 to 20 thousand feet per second) and the practical effect is instantly to convert the whole mass of the explosive into gases which occupy many times the space occupied by the original substance. This causes an extreme violent type of explosion which is called detonation. The suddenness of an explosion of this kind gives rise to an extremely shattering effect. The first inventors of guncotton tried to use it in guns, but it exploded too suddenly, and the effect was to rend the gun to pieces. For this reason gun cotton has never been successful as a substitute for gunpowder. It is extremely successful as a disruptive exploder, however. It has one great drawback, and that was its dangerous sensitiveness. This was finally overcome by the discovery that *wet* guncotton could not be ignited and could only be detonated with relative difficulty. It was also found that a charge of wet guncotton could always be detonated by using a small charge of dry guncotton as a primer. This discovery rendered the use of guncotton for submarine mines, etc., very popular, for it enabled the main mass of the explosive to be rendered harmless by saturating it with water, and keeping the small quantity of dry guncotton needed as a primer at a safe distance until the time came to use it. I was once in the Navy, and at that time torpedoes and mines were filled with wet guncotton. They were stored in magazines, and no dry guncotton was allowed near. The dry guncotton for priming purposes had to be kept on hand, however, and as it was too dangerous to be kept in the magazines, it was in glass jars fastened to the wall in the officers' staterooms. I had the pleasure of having one of these jars of dry guncotton fastened to the wall by the head of my bunk for nearly a year on one ship where I served. I didn't much mind, because it was not likely to cause any trouble unless I offered it violence, and this I was sure never to do I recall with far less composure an incident that occurred sometime later at an Artillery Post. I was in command of a company, and for some reason required the First Sergeant to look up some papers he had in his desk. He was smoking a cigarette and he rummaged around among the various articles in the drawer of his desk. I was watching his absently, and I noticed that the ashes of his cigarette were falling on a yellowish object that looked like a cake of laundry soap. I pushed the drawer gently shut and took the cigarette away from the astonished sergeant. Then I opened the drawer and lifted out the block of guncotton and carefully blew off the cigarette ashes. I soon learned the history of the potential destruction that had been resting under our noses for months. Some guncotton had been destroyed because it was beginning to decompose and was considered dangerous. The sergeant was a souvenir hunter and had salvaged the piece for a desk ornament. If he is still alive I suppose he is out somewhere making a collection of "flu" germs to use for a tooth wash.

Its very fast burning quality was one thing that rendered guncotton unsuitable for use in guns. Finally, however, it was discovered that certain substances, such as acetone, or a mixture of ether and alcohol, would dissolve guncotton. By dissolving it and then drying it out, a hard, horny substance is obtained, which burns with relative slowness, and cannot be detonated at all. This is the ordinary smokeless powder, that I spoke of at the beginning of this article. A similar substance, with a little camphor, some coloring matter, and a stabilizing compound added, makes celluloid. The fact that celluloid and smokeless powder are practically the same compound accounts for the speed with which moving picture films and other celluloid articles burn.

When a charge of smokeless powder in a gun is ignited, it burns many times faster than it would in the open air. This is because all the pressure and heat is confined. There are many problems connected with the size and shape of powder grains. For each size of cannon there is a size of powder grain that is suitable, and that size must be used if good results are to be obtained. It may be positively dangerous to use in one size of cannon a powder prepared for cannon of another size.

Nitroglycerin

The erosive quality of cordite is largely due to its intense heat of explosion, and this, in turn, seems to be a result of the nitroglycerin it contains. Nitroglycerin is in itself one of the most important of explosives, for it is the basis of dynamite. Nitroglycerin is made by the action of a mixture of nitric and sulphuric acids on glycerin. It is a light yellow oily liquid, which looks harmless enough, but which is one of the most violent and dangerous of explosives. For a long time after its discovery, it did not come into practical use because it was too dangerous to transport and handle. The early attempts to put it to practical use were attended by numerous and disastrous accidental explosions. At the present time it is not usually removed from the factory where it is made without first mixing it with some other substance to render it less sensitive. In the early days no such precautions were observed, however. I remember one story about an enterprising agent, who in the early days of nitroglycerin attempted to introduce it into the western mining communities as a blasting agent. He was not successful in interesting anyone in his ware, and finally skipped his board bill, leaving with his baggage at the hotel his sample case of nitroglycerin. No one believed in his explosive, not even the proprietor of the hotel, so when he left, the proprietor didn't bother to get rid of the can of "soup," but left it sitting in the hall of the third floor, where the hall boy found it convenient for blacking shoes on. Finally, however, the nitroglycerin began to decompose, and the boot-black noticed some suspicious smoke or fumes rising from the can and reported to the proprietor. The fact that the stuff was smoking gave the proprietor's memory enough of a jolt for him to remember that it was an explosive. He knew that an explosive that smoked was a bad thing to have around, and he decided to rid himself of it forthwith. To this end he carried the can to his back window and heaved it out into the ever receptive back lot. A three story fall isn't good for any nitroglycerin's disposition, but it is particularly bad if the nitroglycerin in question is made doubly sensitive by incipient decomposition. The result in this case was a complete and thorough detonation of sufficient proportions to wreck the hotel and wake up at least one mining town to the explosive possibilities of the substance.

Dynamite

In 1866 Alfred Nobel discovered that nitroglycerin could be made into a fairly safe explosive by absorbing it in kieselguhr, a porous absorbent earth which will take up three times its own weight of nitroglycerin. Nitroglycerin when thus absorbed is called dynamite. It is in effect a solid, and is reasonably safe and convenient to transport and handle. Dynamite is also made by absorbing nitroglycerin in wood meal. It is a brown or yellowish plastic substance which is usually seen in the form of cartridges or sticks wrapped in paper. It can best be detonated by the use of a fulminate cap. It is sensitive to shock, jar or friction, and should always be handled with great respect. A small quantity may be ignited and will burn quietly without exploding if it is not disturbed. Burning dynamite is, however, extremely sensitive to jar or shock, and any disturbance is likely to cause an explosion. Dynamite freezes easily and in the frozen state is relatively insensitive to shock or friction. Frozen dynamite is extremely dangerous to bring near an open flame. So many fatal accidents have resulted from attempting to thaw frozen dynamite that the practice has become notorious.

T. N. T.

Trinitrotoluol, or T. N. T., as it is more commonly called, is the result of treating the coal tar product toluol with a mixture of nitric and sulfuric acids. It is a very popular explosive, as can readily be seen by the variety of names it has. Among them are Trinitrotoluol, Trinitrotoluene, T. N. T., Trinol, Trotyl, Tolite (France), Trilit (Spain) and Trilolo (Italy). It is one of the most violent of explosives, but is also supposed to be one of the safest to handle and transport. It is a brown substance which can easily be melted and molded into any form desired. It is much used as a filler for shells, hand grenades, submarine mines, torpedoes, etc. Its safety in handling comes from the fact that it is almost impossible to explode it under ordinary conditions without using a strong fulminate cap. It cannot be exploded by friction, shock, or fire. If ignited, it burns with a black smoke. Its sensibility can be demonstrated by firing a rifle bullet into a block of T. N. T. at close range. Even this will not cause it to explode. However, when it comes to dealing with high explosives, it is never safe to be careless. I remember some very sound advice in an old book on military explosives. It said: "After lighting the fuse, remove yourself with celerity, to a place of safety." Likewise, when speaking of high explosives, I would say: "No matter how safe it is, don't take chances." It was the extremely safe and inert T. N. T. that destroyed Halifax.

The Current Supplement

THERE have been several recently published studies of that ever interesting and intelligent insect, the Honey Bee; perhaps many will find a study of the honey-yielding organs of flowers equally interesting. Believeing that this is so we are publishing in the current SCIENTIFIC AMERICAN SUPPLEMENT *for July 12th, being No. 2271*, the results of a long and careful series of studies of the nectaries of flowers whence the bee secures material for *Honey*. It is most interesting to find that the nectaries and the nectar are really the food of the flower itself rather than of the bee. Somewhat related is another and illustrated article showing how *The Fruit-grower's Sleight of Hand* prevails over Nature and furnishes us with fruits whose practical perfections the good lady herself rarely attains.

A valuable discussion of *Radiometallography*, held recently in London, presents abstracts of a number of papers dealing with the use of X-rays in studying the structure of metals and airplane timber, and points out to what extent these rays were actually useful, finally, in the rapid testing of materials during the past five years. Another novel application growing ing out of those years of stress is the *Cast Steel Ship Development* which is carefully described in the same issue. At this time, also, it is interesting to read the very readily understood exposition of *Design of Artillery Ammunition* with its instructive and simple illustrations which make clear the designs of the uncanny fuse, the pressures experienced by the guns and the virtues of different kinds of explosives. Not least valuable among the papers of this issue is the address on *Recent Researches on Cholera*, by Sir Leonard Rogers who traces the improvements in the treatment of that dread disease and presents most hopeful figures indicating that an efficient method for combating the resultant mortality has at last been developed.

A surprisingly attired lizard, *Dimetrodon gigas*, is illustrated and its probable habits discussed, together with a longer paper discussing *The "Terrifying" Position in Animals* of several classes. An important paper by Kunz presents a readable account of *Platinum and Palladium in Brazil*, showing that deposits of some importance —under present conditions—occur in that country and deserve more attention than heretofore given them. Shorter papers deal with *Influence of the Wind on the Distribution of Glaciers*, *Specific Character of Precious Stones*, and a number of illustrations show the workings of the *Slate Quarries of Anjou*.

The Revival of the Torpedo Boat

(Continued from page 27)

heavy machine gun-fire and, although they were frequently hit, the little craft succeeded in regaining port.

The earliest type had the following dimensions: Length, 40 feet; breadth, eight feet six inches; extreme draft, three feet. The hull was built with an angle or chine piece on the bow which prevented the bow wave from rising and threw it down laterally. The type of forebody which proved so effectual in the "Miranda" class of 1910 retains this angle in the bow in conjunction with concave sections below it, which become flatter and re-curve as they get to the step. The after body is pinched in and hollow on the keel line, with the effect that the water, after leaving the step, runs clear of the boat until just before it reaches the transom. With a 250-horse-power motor the first boats developed a speed of well over 30 knots. They carried one 18-inch torpedo in a rack let into the deck at the stern, the after end of the rack extending well beyond the stern and thus serving the same purpose as the "spoon" of a torpedo tube.

The method of attacking was simple and proved to be effective. When the enemy was sighted the coastal motor boat headed for it at full speed, the torpedo being launched tail first over the stern by means of a launching ram, as soon as the target was in range. Immediately after letting go the torpedo, the helm was thrown hard over and the boat turned off, as shown in the insert sketch on our drawing, the torpedo racing past on the original course toward the target.

Later, the firm built for the Admiralty large numbers of a larger type, 55 feet in length. This is the boat shown in our drawings. The dimensions were: Length,

(Continued on page 46)

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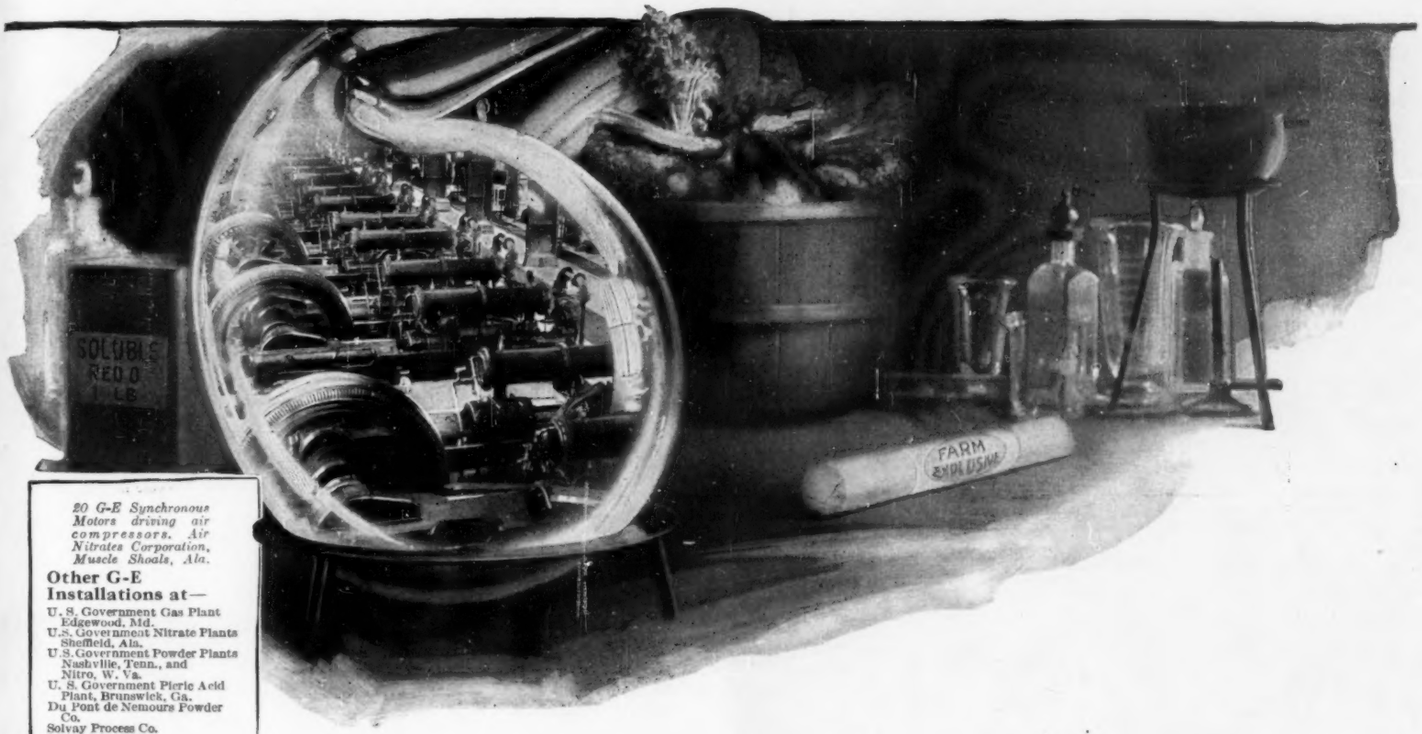

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The Revival of the Torpedo Boat

(Continued from page 44)

55 feet; beam, 11 feet; extreme draft, three feet. Provision was made for two torpedoes, and for defense against aircraft and small surface vessels four machine guns were carried. It should be noted that some of the 55-footers were armed with one torpedo and four depth charges. They were driven by 375-horse-power motors, which at 1,250 revolutions gave a speed of 38 knots. When fully opened out they made 41 knots and over.

The work of the C. M. B.'s during the war was not confined to torpedo attack. All these little fellows—"scooters" as they came to be termed in the navy—were gradually called upon to perform multifarious duties. They were very active off the Belgian coast and Belgians who lived through the German occupation stated that the enemy had conceived a wholesome respect for them. Frequently they came under fire from the German batteries, and more than one was lost as the result of a direct hit with a shell. They had no fear of destroyers and frequently intercepted the German boats when they were returning from raids on the Dover barrage. Their very high speed enabled them to get away from the destroyers after delivering an attack. Enemy airplanes, however, were a more serious matter, for these attacked them with bombs and machine-gun fire.

Some of the best work of the C. M. B.'s was done in the blocking operations at Zeebrugge and Ostend. Their work was to create smoke screens (which they did by moving ahead of the other vessels at full speed and sending out smoke clouds from the exhaust by means of a special smoke-producing device), and to lay down flares, to show where the block ships were to turn. At Zeebrugge two of them entered the harbor to torpedo a vessel alongside the Mole, others, temporarily armed with Stokes mortars, attacked the airplane hangars. Also, when the "Vindictive" was sent in to block Ostend, two coastal motorboats were given the work of torpedoing the ends of the piers, so as to put the guns which were mounted thereon out of action.

Bunkering Big Ships

(Continued from page 35)

in getting coal out of the way. The legs are necessarily long in order to meet varying conditions as to depth of point of digging and height of port hole. The bucket runs thus often extend above the level of delivery to the chutes descending to the ports. But this does not mean that the coal is carried higher than necessary for the delivery chutes. The loads are spilled at the proper level and the buckets are empty when they run up and down the portion of the leg above. Consequently, the power is not uselessly consumed in an excess handling of coal.

What has been occupying our attention is the portable part of the complete bunkering apparatus. There remains for our consideration the fixed and permanent part. This is installed in the ship itself and there made a part of it, just as the boilers and engines are a part. It consists essentially of the electric motor which supplies power, and the trimming units. The coal is chuted in at the port. The trimming plant undertakes the automatic distribution in such way as to utilize the stowage space with economy. A number of disks are horizontally installed to rotate close up to the ceiling of the bunker. Their operation is secured by a power transmission through gears and chain belts. As the disks rotate but slowly, it is necessary to reduce the rotational speed of the motor shaft; and this is done in connection with the transmission. The arrangements are such that individual disks may be thrown out of action upon occasion. The group in a bunker space is so distributed that a plan view would show

(Continued on page 48)

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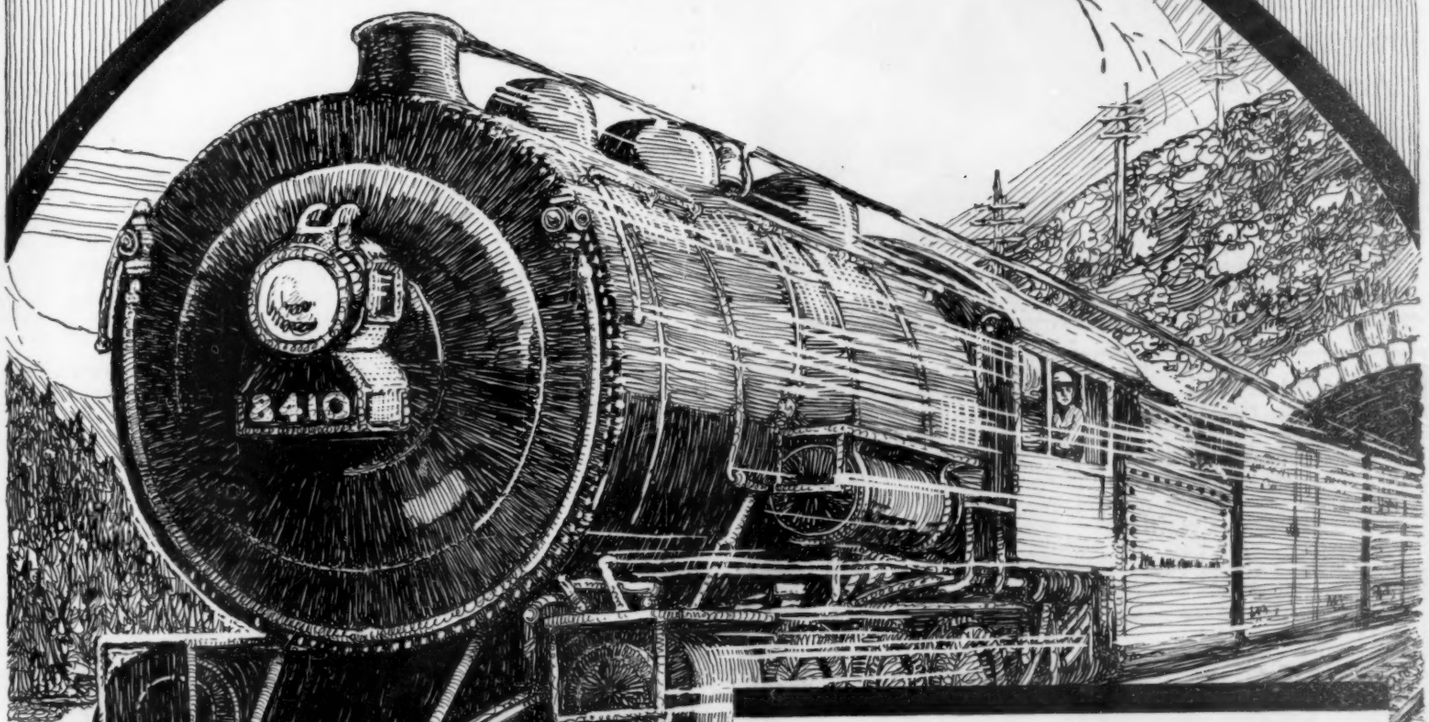

The Development of Rail Transportation

IN the days of Thomas Jefferson the ideas of the people were bounded on the west by the Alleghanies. Wise ones said that it would take a hundred and fifty years for civilization to reach the Pacific. But they reckoned without the railroad.

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But without the power of explosives this great transportation system could never have been developed. Without dynamite we could not mine sufficient iron to make the rails and build the locomotives and cars, or enough coal to drive the trains that now move more than a million tons of freight each year.

Dynamite smoothes the road bed, digs the tunnels and fills the gullies—without it, the great steel pioneers could never have pushed into the Golden West; the country beyond the Alleghanies would still be a sparsely settled wilderness traversed only by the weekly Overland Stage.

In the past Hercules Explosives have been used extensively in building our network of railroads. They will play a still more important part in developing the greater transportation systems of the future.

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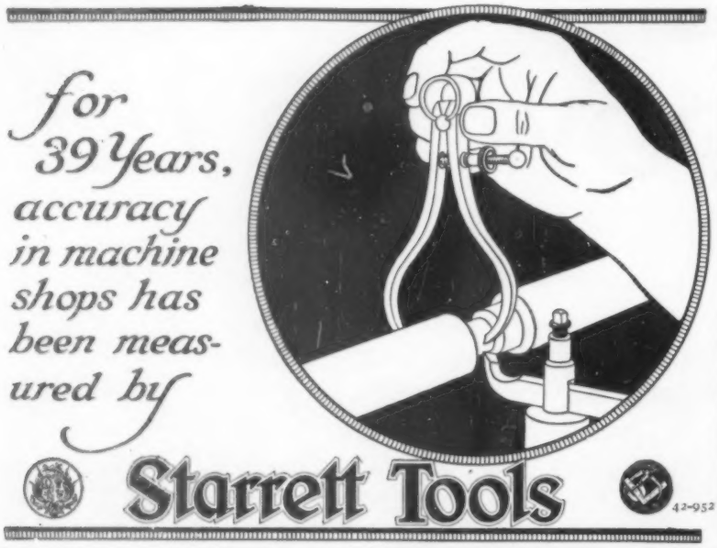

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Bunkering Big Ships

(Continued from page 46)

a line of them, the various disks being each tangent to its neighbors. The coal is received by one disk and transferred, if necessary, to the next and so on until the bunker is filled.

In general, the disks are not put into operation until the incoming coal has piled up to or upon one or more, near the hatch opening. Theses are then started up. Fixed deflectors, called plows, are suitably arranged to effect the removal of coal on the corresponding disks. This coal piles up on the floor and ultimately reaches up to adjoining disks; or it may indeed even encroach on the top surfaces more or less. These disks are then put into action. In this way the bunker is filled up to the disks from one side to the other. After the coal has filled up the region near the hatch, the fresh coal coming in is passed over the pile from disk to disk until it reaches a place where it may fall off and pile up. The transfer from disk to disk is effected by fixed deflectors. The deflectors are both straight and spiral and are disposed to suit the layout of the disks and the general situation.

The trimming mechanism is understood to be competent to receive at a single port and to transfer and trim 150 tons per hour. This allows a margin over the delivery capacity of the digging and conveying apparatus, which fact tends, naturally, to the prevention of congestion at the point of delivery. It is said to be also in excess of delivery by any known means.

The Farmer and the Patent System

(Continued from page 36)

ventor's mind to the practical, durable, salable form often requires the expenditure of years of effort and thousands of dollars before any returns are had; so that it is safe to say that very few would expend their energies and resources if it were not for the inducements offered by our patent system.

Congress concluded that the most equitable manner of rewarding the inventor was to give him a monopoly for a limited time of the manufacture, use, and sale of his invention. This monopoly induces him to labor untiringly to create an invention, to put it in the most practical form, and to introduce it as thoroughly as possible in order that he may get the largest possible amount of profit.

If, as often happens, a given invention is of little practical value, its sales will be small, while from an invention of great utility the inventor may, and probably will, reap large profits; but this is only for a limited time, after which the invention will become public property. The reward is thus in just proportion to the benefit which the public derives from the invention.

The manufacturer of farm implements, on whose head the resentment of the farmer is sometimes showered because of the supposed larger prices of the agricultural machines covered by existing patents, would be glad to be relieved from the danger of strikes to the extent to which the farmer has been emancipated by the machinery furnished by means of the patent system.

If the farms of today, which are many times larger than those of the last century, were operated with the hand implements of those days, the labor problem would become as serious to the farmer as it is today to the manufacturer.

Seeing, therefore, how absolutely necessary is the patent system to the welfare of the farmer and to the country at large, he should instruct his representatives that the patent system is to receive their earnest support, and that time spent in so changing the patent laws and their operation as to give the strongest practical incentive to the inventor which is compatible with the greatest ultimate advantage to the public, will be appreciated as highly as any other efforts he can possibly make.

Rotating Projectiles from Smooth-Bore Guns

(Continued from page 38)

to employ heavy charges so as to get very high speeds of flight, but within the range of experiments I have found by shooting through a succession of paper screens and observing the holes with a theodolite that within the length of the observatory enclosure there is no measurable lateral deflection of the projectile while in flight. Truly round holes are always left by the rotating projectiles. Very striking results were obtained in an experiment made in Virginia in the presence of a number of ordnance officers. Two successive shots were fired at a target in one of which the projectile was made to rotate by means of the included charge and in the other of which the projectile was fired by powder outside of itself. In the one an excellent hit was made, leaving a true round hole, while in the other it happened that in the tumbling of the shell in the air it reached the target exactly broadside. The officers were naturally much impressed by this striking exhibit.—*From paper delivered before the National Academy of Sciences.*

Smothering a Fire Beneath a Combustible Blanket

(Continued from page 38)

blanket of highly combustible material is a startling one; but in the utter exclusion of oxygen it is a wholly sound one. And if on the other hand the bullet penetrates the upper portion of the tank, where there is no fuel, there is likewise here no air in sufficient quantity to give the basis for an explosion; for the venturi suction has taken care of that. So again the incendiary bullet is smothered, this time in a blanket of nothing at all.

Final tests of the Weinberg tank were made at Dayton. Two identical tanks, one made after the Weinberg plans and the other covered with elastic materials prepared by the War Department, were shot at side by side with armor-piercing and incendiary bullets. The second tank caught fire after the third shot; the Weinberg tank was penetrated by 15 piercer bullets followed by seven incendiaries, with neither leak nor explosion.

A bullet rarely goes completely through a fuel tank; ordinarily it is so checked in passage through the near wall and the fluid that it falls, spent, to the bottom of the tank. Through the Weinberg invention, which prevents it from igniting the gasoline in passage through the tank, or in repose therein, the tank that formerly possessed the greatest danger for the aviator becomes now his best protection. Moreover, a tank which eliminates danger of fire and leaks should be of value in peace as well as in war, and in many other places than on airplanes.

The Action of Iron Rust in Contact with Other Metals and Alloys

TWO German scientists connected with the German Institute for Testing Materials, have recently conducted experiments with the object of ascertaining the degree of influence exerted by contact with another metal upon the corrosion of iron in a one per cent solution of sodium chloride at 18 degrees C.

In every case in which two metals are in contact the most "noble" metal is much less corroded than when it alone is placed in the solution; this protection is obtained at the expense of the more electro-negative metal. The effect is less marked in solutions of a low degree of electric conductibility. Magnesium and zinc can thus be employed to protect iron, zinc being the better for this purpose because of the readier disintegration of magnesium. In contact with copper iron is much more strongly attacked than when alone.

The authors of the experiment designate by the name of the "Limit of Protection" the current in amperes per square centimeter which is exactly sufficient to prevent corrosion.

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Men who never before could smoke a pipe and men who've smoked pipes for years all testify to the delight P. A. hands out! It hits the universal taste. *That's why it's the national joy smoke!* And, it can't bite or parch. Both are cut out by our exclusive patented process!

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You buy Prince Albert everywhere tobacco is sold. Toppy red bags, tidy red tins, handsome pound and half pound tin humidors—and—that classy, practical pound crystal glass humidor with sponge moistener top that keeps the tobacco in such perfect condition.

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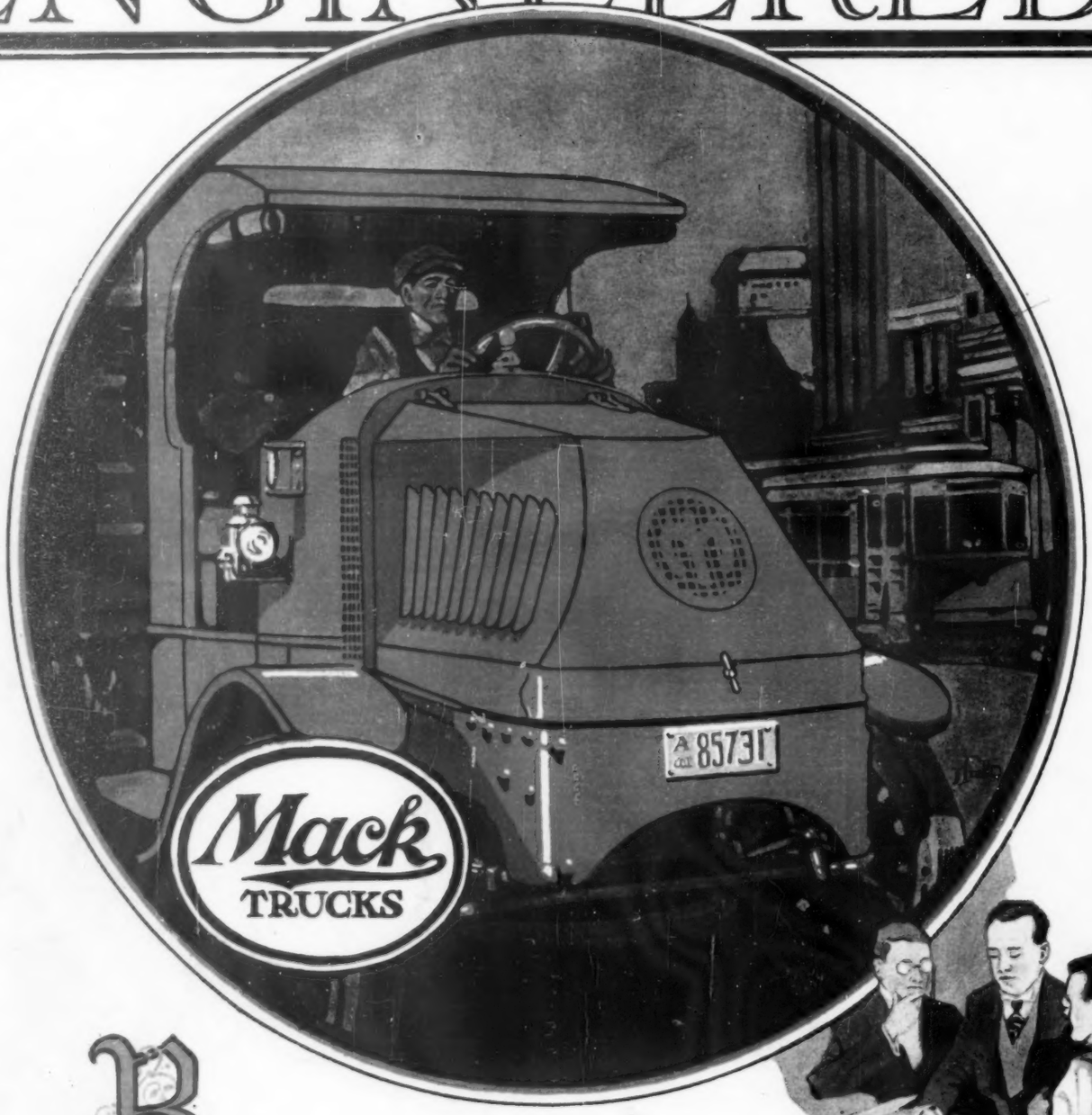

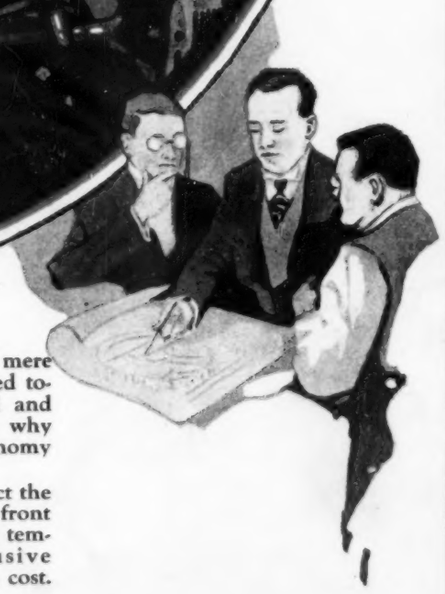

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